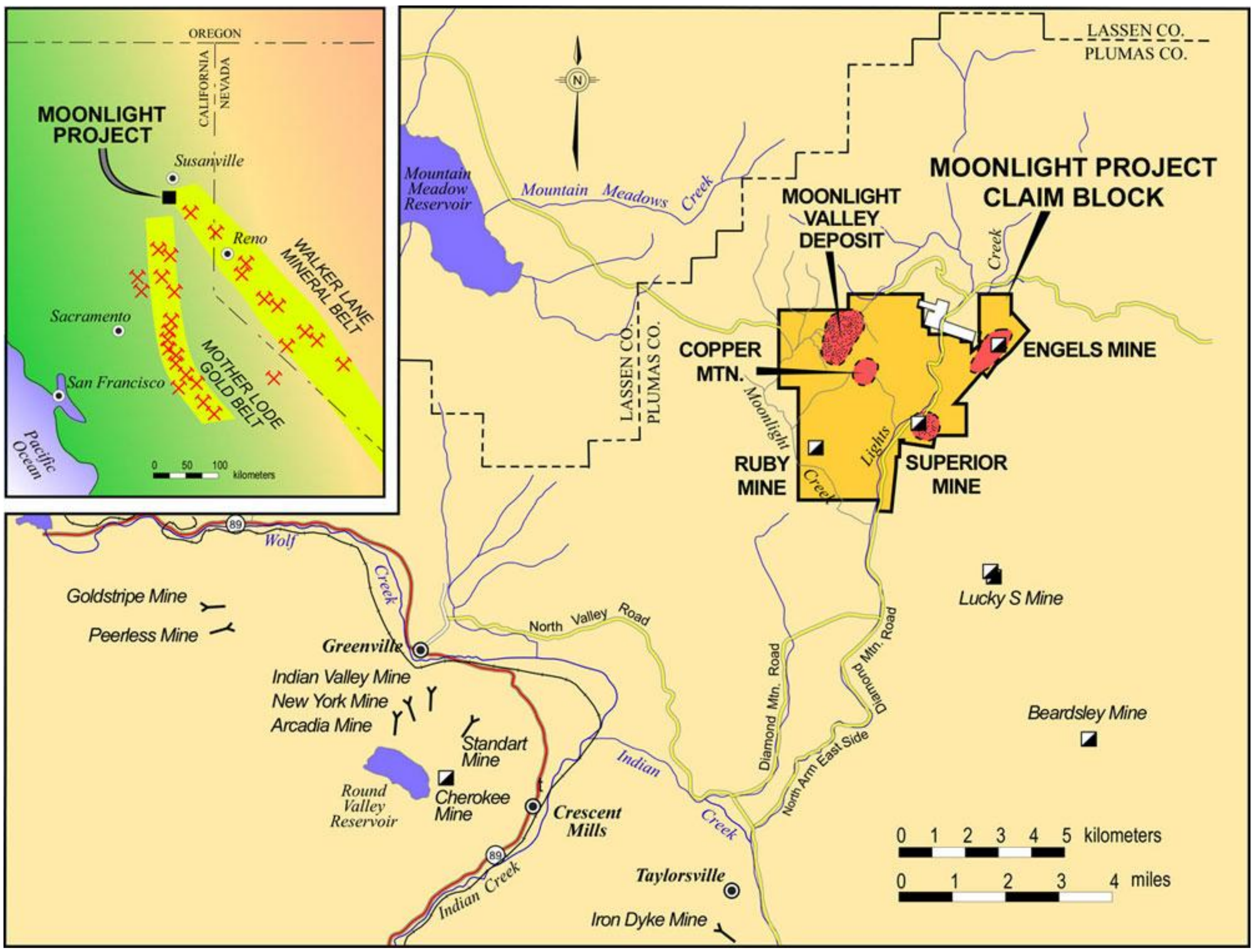
ROADSIDE GEOLOGY AND MINING HISTORY OF THE MOTHER LODE
2008
PART 3: GRASS VALLEY TO WALKER BASIN
PLUMAS COPPER BELT

Gregg Wilkerson and David Lawler



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Buena Vista Museum of Natural History

ROADSIDE GEOLOGY AND MINING HISTORY

OF THE MOTHER LODE

Gregg Wilkerson and David Lawler

Copies of this guidebook series are available through

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Contents

Acknowledgements

Barbara Bania proof read this manuscript and it is a much better product for her efforts.

George Saucedo provided invaluable assistence with reproducable copies of the geology for the Chico and Sacramento State Geologic map sheets.

INTRODUCTION

This field guide series follows, with modifications, California Division of Mines and Geology Bulletin 141 which was published in 1949. Incorporated for that portion of the trip from Mariposa to Placerville is information provided by Landefeld and Snow in Yosemite and the Mother Lode Gold Belt, American Association of Petroleum Geologists Book GB68, 1990. In our guidebook, sections that are adapted from the 1949 field guide are noted by the reference "Bowen and Crippen, 1949". Those sections that are adapted from the 1990 guide are noted by the reference "Landefield and Snow, 1990".

Help us make this web document better!

To contribute photographs or information about the mines and history of the Mother Lode, please submit to Gregg Wilkerson for inclusion in future versions of this compilation at Gregg_Wilkerson@blm.gov.

Mine Production Statistics

All mine production values are from the 1941 or 1991 guides. Most of those values were presented in dollars. They have been converted in this guide to ounces using the assumption that between 1849 and 1949 the average value of gold produced in California was $25.00 per ounce.

Milage Markers

Whenever possible, this field guide is keyed to highway milage posts with the denotation "MP."

Map Scales

Most of the geologic maps of the field trip route in this guidebook were produced at a scale of 1:24,000. Some of these geologic road maps are 1:30,000 or 1:40,000. The regional geologic maps are produced at a scale of 1:50,000. The printer you use may produce these maps at different scales. All maps on this web site are in .pdf format.

Overview

California State Highway 49, variously known as the Mother Lode Highway or the Golden Highway, traverses over 270 miles of the Sierra Nevada, beginning at Mariposa on the South and ending at Sattley on the north. It passes through nine counties, each of which represents an important part of the Sierran Gold Belt (Bowen and Crippen, 1949).

This entire region has come to be known generally as the "Mother Lode Country", but more technically speaking, the Mother Lode is a belt of gold-bearing quartz veins which appears to start at Mariposa and to terminate at Georgetown in Placer County and which are associated with the Melones Fault. It forms a more or less continuous belt of quartz veins that occupy a fault zone approximately one mile wide and 120 airline miles long. The 10-mile segment of this belt between Jackson and Plymouth is its richest section and was the source of one-half the gold produced in the entire 120-mile extent, which has amounted to a quarter of a billion dollars. It is noteworthy that this 10-mile segment lies at the bend in the belt where its trend changes form northwest to nearly due north. The Melones fault structure (Clark, 1964, 1970) with which the Mother Lode quartz veins are associated may possibly extend 50 miles farther northward to Downieville through Quincy. This guidebook series uses the more general definition of "Mother Lode" and provides an overview of the geology and mining history from Mariposa to Quincy.

Highway 49 leaves the Melones Fault Zone at Placerville and swings 10-15 miles to the west, traversing the even more productive Grass Valley-Nevada City district and other gold-bearing areas of the northern Sierra Nevada (Bowen and Crippen, 1949).

The veins range from great white quartz masses 150 feet wide, down to stringers less than the thickness of one's little finger. The thickness of a vein is no criterion as to its potential value. Rich pocket mines such as those of Jackass Hill were found largely in narrow veinletts, whereas the massive silica-carbonate rock of the Penon Blanco is practically barren of gold (Bowen and Crippen, 1949).

Mining methods and techniques developed in the California gold belt have spread to the far corners of the earth and have become standard practice everywhere. Many famous technicians and financiers had their training in the Mother Lode Country before attaining even greater distinction and achievement in other fields. Bret Harte and Mark Twain owe much of their reputation to the gold country, and through their stories the romance of the region has become familiar to all the world (Bowen and Crippen, 1949).

Although so much has been written of the history, romance, and folklore of the Sierra Gold Belt, little of general geologic interest has been published for the use of the traveler. The following notes on geology along Highway 49 attempt to correlate the geologic, mining, historic, scenic, and cultural features encountered as one travels north along the route from Mariposa to Yuba Pass and Sierra Valley (Bowen and Crippen, 1949).

Geology maps 1 through 23 are described in Part 1 of the Mother Lode Guidebook Series: "Mariposa to Jackson, 2006 Edition."

Geology maps 24 through 36 are described in Part 2 of the Guidebook Series "Jackson to Grass Valley, 2007 Editon." This guidebook describes the geology and mining history of the Mother Lode between Grass Valley and Taylorsville. It also describes the copper deposits of the Walker Basin

GRASS VALLEY TO NORTH SAN JUAN

GEOLOGY MAP 36

North Star Mine to Nevada City

(Saucedo and Wagner, 1992; Lindgren et al., 1886a)

(Tuminas, 1983; Yeend, 1974, Bobbitt, 1982; Hacker, 1984)

0.0 Junction, Federal Highway I-80 and State Highway 49

21.2 Hansen Brothers Gravel Operations.

GRASS VALLEY (#231, 234)

21.7 Grass Valley city limit.

Grass Valley is one of the most beautiful historic mining town in the Northern Sierra. Mining camps the world over are notoriously ugly and uncomfortable places to live, but Grass Valley is set in a well watered coniferous forest of great beauty. Many stands of large trees have been spared the loggers axe and tower in dark green borders about broad meadowlands. The entire aspect of suburban Grass Valley is park-like. Even the mine dumps and buildings are more or less masked by trees so that the scenery suffers little by their presence. The business district of town is much like that of other Sierran towns (Bowen and Crippen, 1949).

23.9 Grass Valley is connected to the overland route through Reno via Highway 20 which joins Highway 49. A railroad once connected Nevada City and Grass Valley to the transcontinental route of the Southern Pacific but the tracks have been removed. Aside from explorations of Spanish Americans of which there is no record, Grass Valley was first visited by French emigrants in 1846. Gold miners from Oregon spent considerable time there in 1848 but the first permanent settlers who were emigrants from the east arrived in 1849. Historical spots in Grass Valley are numerous. The careers of such famous names as Lola Montez and Lotta Crabtree are closely associated with the history of the town. Its lode mines constitute the most productive group of gold properties in California and rank among the richest in the nation (Bowen and Crippen, 1949).

Figure 1. Grass Valley mill building, 1949 (CDMG Bull 141:157).

Figure 2. Grass Valley Clug Cafe side wall, 1949 (CDMG Bull. 141:157)

Figure 3. Stone house on Mill Street, Grass Valley (CDMG, 1949:158).

Figure 4. Boston Mine monitor, 1895 (CGS Photo A4445).

Figure 5. Providence Mine, Grass Valley, 1893 (CGS Photo CDMG Photo C6651)

Figure 6. Scotia Mine, Grass Valley, 1877 (CGS Photo A7138a).

Figure 7. Stewart Mine, Gold Run, Grass Valley, 1896 (CGS Photo A7877).

The geology of the Grass Valley mines differs greatly from that of those between Auburn and Mariposa. Very little large scale faulting is in evidence in the Grass Valley district. The Mariposa slate and Calaveras Complex are largely absent, replaced by the Lake Combie Complex and other and metamorphic terrains. The host rocks in the Grass Valley District are generally Paleozoic-Mesozoic massive diabase which has been intruded by Mesozoic quartz diorite. The main veins dip on an average of 35 degrees whereas most Mother Lode veins are steeply dipping . The minor cross veins are usually not mineralized except at their intersections with main veins. The wall rocks of the Idaho-Maryland (#232) and Spring Hill (#233) mines are principally gabbro and serpentine; those of the Empire Star (#231) and Golden Center (#234) are quartz diorite, meta-andesite, diabase, and Lake Combie Complex schist. Vein forming minerals from the Grass Valley district include ankerite, native arsenic, arsenopyrite, chalcopyrite, chromite, epidote, galena, gold, magnetite, mariposite, pyrite, pyrrhotite, sphalerite, and rarely molybdenite, scheelite, hessite, and altaite. The latter two are tellurides of gold and lead respectively. Wall rocks in the district are heavily watered above the 1,500 foot level and water flowed constantly into the lowermost workings necessitating use of elaborate pumping systems. Pumps which handled 3,000 gallons per minute were used in the wettest spots. Although exceedingly humid, Grass Valley mines were among the coolest in the world. The temperature increase or geothermal gradient below ground is less than 1 degrees Fahrenheit per 100 feet (30 m) of depth (Bowen and Crippen, 1949).

Between sites #235 and #246, the area around Grass Valley is mostly underlain by rocks of a 160 m.y. old Jurassic (Oxfordian) plutonic suit that is part of the Central Belt Fiddle Creek Terrain.

22.5 Highway 20 East turn off to West Empire Mine Street.

22.7 West Empire Mine Street. Turn right at the stop sign and go east on Empire Street to the intersection of South Auburn Street and West Empire Mine Street.

23.0 The Empire Market is on the SW corner of the intersection. Go straight (east) toward the Empire Mine. The rocks in this area are metavolcanics and granodiorite.

23.8 Borne Mansion on the right (south).

EMPIRE MINE STATE PARK AND VISITOR'S CENTER (#231)

EMPIRE-STAR MINES (Section 35)

The Empire Mine State Historical Park is on the East Empire Street, east of Highway 49.

The Empire Mine (#231) was originally located by George D. Roberts in October 1850. In the spring of 1854, the Empire Mining Company was incorporated and in 1865 new works, including a 30-stamp mill, were erected. In 1869 Wm. B. Bourn, Sr. purchased the Empire, when he died, Wm. B. Bourn, Jr. took over its management (California Historical Landmark No. 298).

The Empire-Star Mines Company, Ltd became the largest mining operation in Grass Valley. The Empire-Star is a consolidation of the major North Star, Pennsylvania, and Empire mines and a host of lesser workings. The Empire began operations in 1851 and was in continuous operation through 1956, except when forced to close during World War II. During this period, most of the shafts were shut down. The mine working faces had gold in them at the time of closure, and they soon filled with water and have remained so ever since. The underground workings of the Empire-Star total more than 367 miles (589 km) in length making it one of the most widespread mines in existence. It has been mined to an inclined depth of more than 11,000 feet (3,350 m) or a vertical depth of over a mile (1.6 km). The total production of the Empire-Star group has been in excess of 5,800,000 ounces ($120,000,000). For the locations of the various shafts of the Empire-Star and other Grass Valley mines see the accompanying map in this guidebook (Bowen and Crippen, 1949).

Guided tours of the Empire Mine are available and highly recommended.

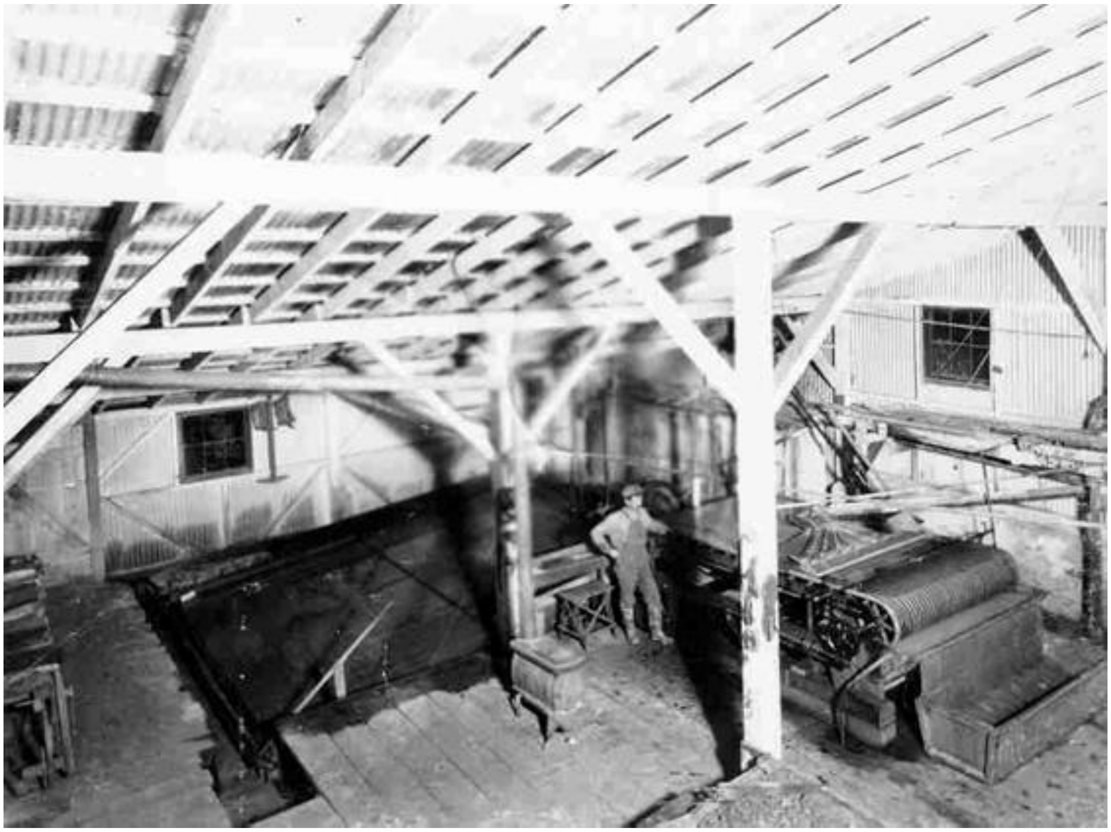


Figure 8. Empire Mine slime plant, 1890 (CGS Photo A3503).

Figure 9. Empire Mine, twin skips with men, 1890 (CGS Photo A3489).

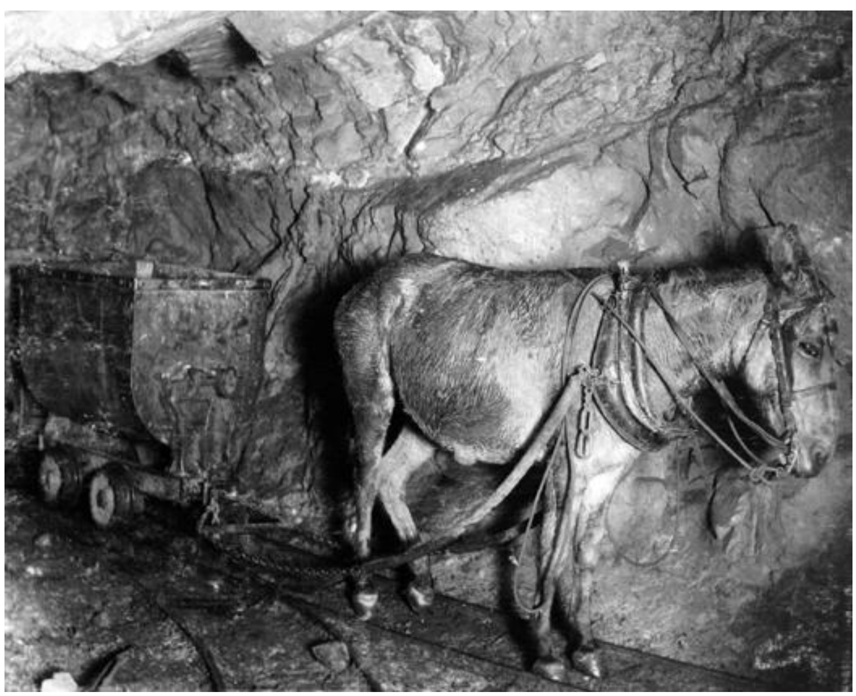


Figure 10. Empire Mine, mule and mine cart, 1890 (CGS Photo C5154).

Figure 11. Mercury amalgam cleanup, Empire Mine,1900 (CGS Photo C5168).

Figure 12. Cornish miner, Empire Mine, 1900 (CGS Photo A5188).

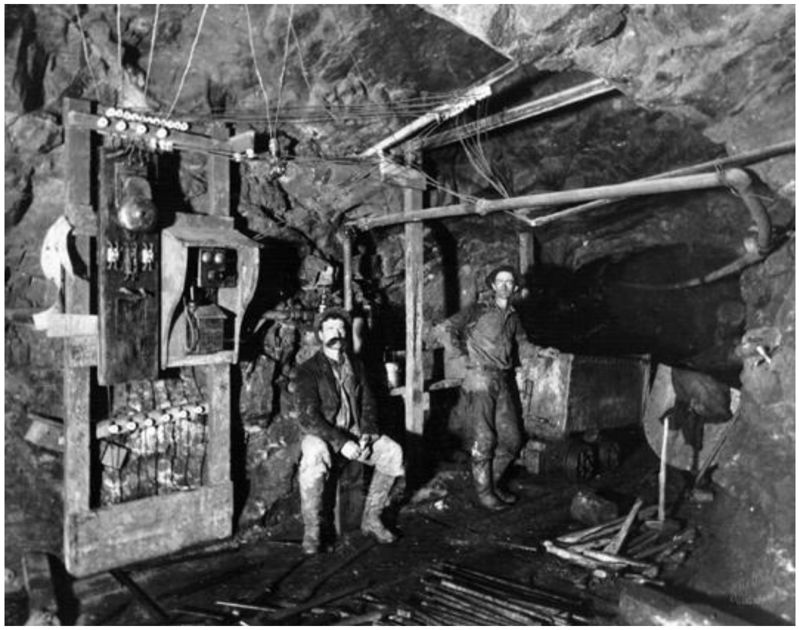


Figure 13. Drillers at communication station, Empire Mine, 1900 (CGS Photo C3500).

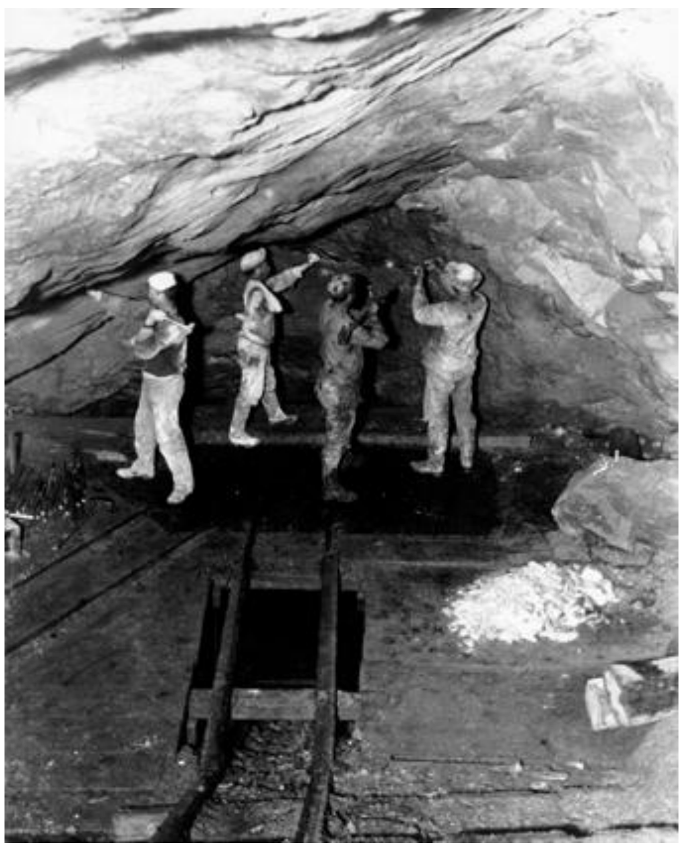


Figure 14. Four miners drilling, Empire Mine, 1900 (CGS Photo C3504).

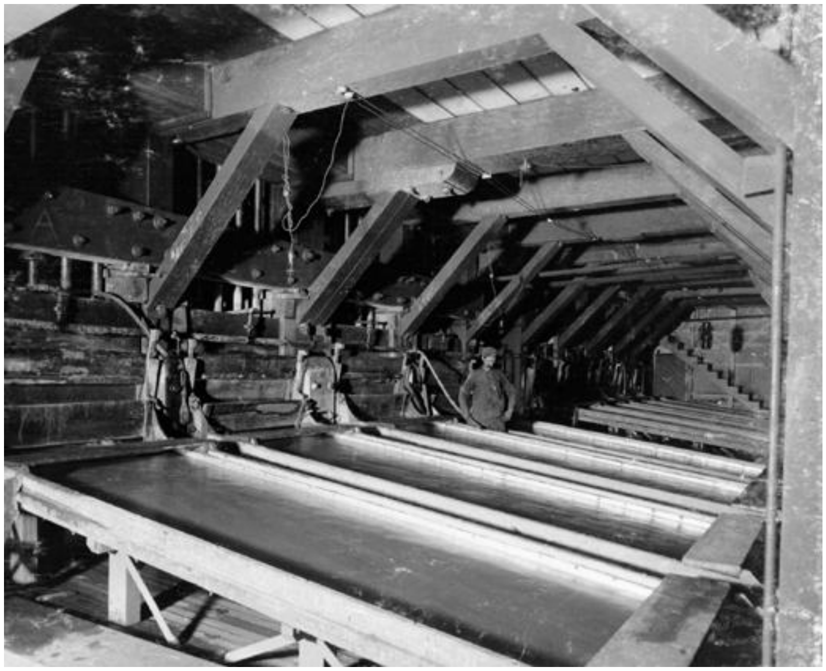


Figure 15. Empire Mine mill battery with amalgamation plates (CGS Photo C5163).

Figure 16. Miner lighting fuse, Empire Mine, 1900 (CGS Photo C5163).

Figure 17. Miner with candle and single jack drill, Empire Mine, 1900 (CGS Photo C3501).

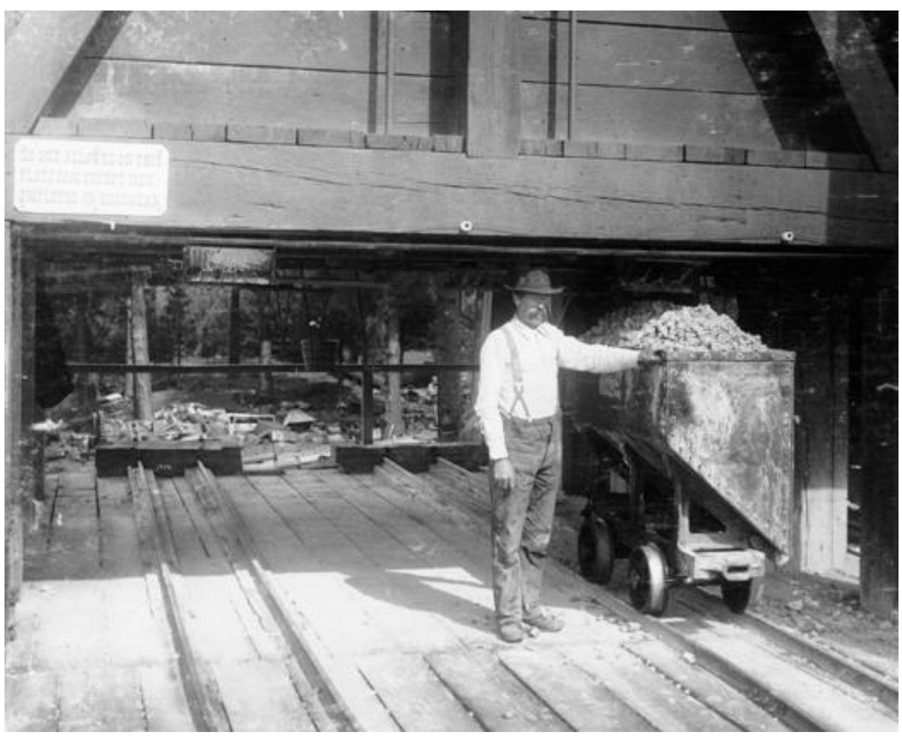


Figure 18. Ore bins under head frame, Empire Mine, 1900 (CGS Photo 5162).

Figure 19. Dumping ore from cart into ore shoot, Empire Mine, 1900 (CGS Photo A3501).

Figure 20. Ore pass, Empire Mine, 1900 (CGS Photo C4084).

Figure 21. Pneumatic drill and two drillers, Empire Mine, 1900 (CGS Photo A7151).

Figure 22. Oscillating gold recovery table, Empire Mine, 1900 (CGS Photo A3526).

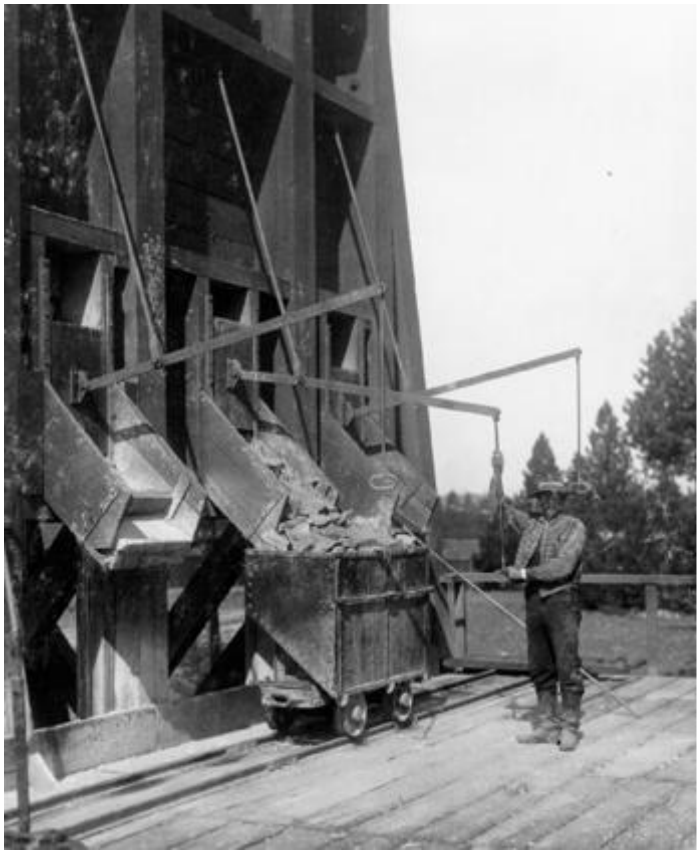


Figure 23. Waste rock shoot loading from storage bins below head frame, Empire Mine, 1900 (CGS Photo C5159).

Figure 24. Empire Mine Mill, 1949.

Figure 25. Blacksmithing demonstration, Empire Mine,2002.

Figure 26. Secondary headframe, Empire Mine, 2002.

Figure 27. Core from ventilation shaft drilling program, Empire Mine, 2002.

Figure 28. Superintendent offices, Empire Mine, 2002.

Figure 29. Stamp mill foundations, Empire Mine, 2002.

Figure 30. Superintendent's Office, Empire Mine, 2002.

Figure 31. Smelting furnace, Empire mine, 1900 (CGS Photo C5177).

Photo 9. Shop buildings at the Empire Mine, Grass Valley District. The mine property is now part of the Empire Mine State Historic Park. *Photo by Max Flanery.*

Figure 32. Shop building, Empire Mine (CGS, 1997:155).

Across the road, to the north, from the Empire Mine parking lot is the headframe and ore storage and loading structure for the Rosalinda Mine.

Figure 33. Headframe for Rosalina Mine, Empire Mine State Park, Oct. 19, 2008.

Figure 34. Rosalinda Mine ore loading structure. Oct. 19, 2008.

Return to Highway 49. Reset odometer

Between the Empire Mine and Nevada City, Highway 49 crosses Mesozoic quartz diorite, Lake Combie Complex diabase, ultramafic rocks and gabbro, Miocene-Pliocene volcanics and Jurassic granite.

0.0 Highway 49 and West Empire Mine Street. Go straight over the Highway 49 overpass to Mill Street.

Mill Street turnoff. Take the turnoff and circle back to the right to North Star Powerhouse Road.

NORTH STAR MINE POWERHOUSE (#230)

The North Star Powerhouse Museum is southwest of the intersection of highways 49 and 20. It was built by A. D. Foote in 1895, was the first complete plant of its kind. Compressed air, generated by Pelton water wheels, furnished power for the entire mine operation. The 30-foot Pelton wheel was the largest in the world, and was in continuous use for over 30 years (California Historical Landmark No. 843).

The North Star Power House Museum has a display of the 30-foot Pelton wheel and a reconstructed Cornish pump used to dewater the mines.

Figure 35. Pelton wheel, North Star Powerhouse Museum (photo from their web site, March, 20007).

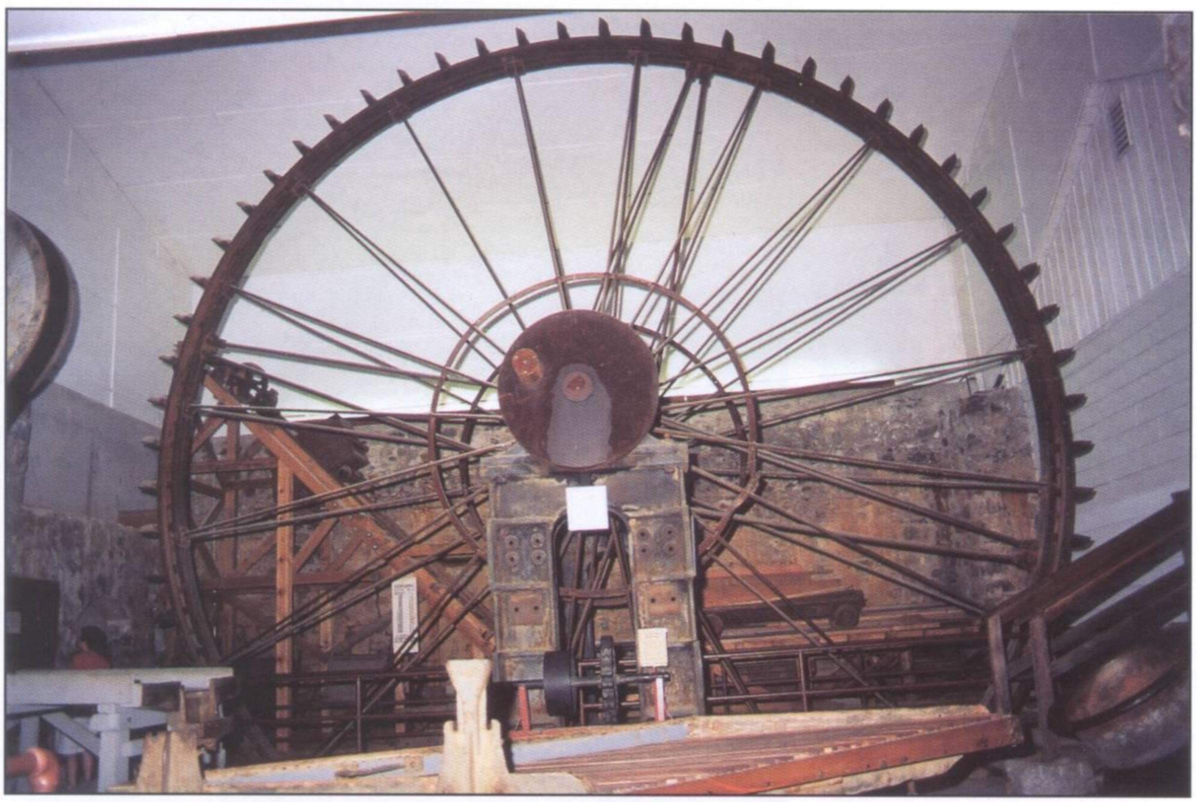


Photo 6. At 30 feet in diameter, this is the largest Pelton wheel ever constructed. The wheel was used to generate hydro-electric power for mining operations in the area; it is displayed at the North Star Mining Museum in Grass Valley. *Photo by Max Flanery.*

Figure 36. 30-foot diameter Pelton wheel, North Star Powerhouse Museum (CGS, 1997:153).

Figure 37. Cornish pump, North Star Powerhouse Museum (photo from their web site, March, 2007).

Photo 7. This Cornish pump assembly provided a means of dealing with one of mining's biggest problems—the removal of water. This was actually a pumping system; a way to drive numerous pumps at various depths within the mine. This assembly is now displayed at the North Star Mining Museum in Grass Valley. *Photo by Max Flanery.*

Figure 38. Cornish pump, North star Powerhouse Museum (CGS, 1997:153).

0.4 Turn left at stop sign to go through Old Town Grass Valley.

GOLDEN CENTER MINE (#234)

The Golden Center Mine (#234) is located in the heart of the business district of Grass Valley. Although the surface extent of the Golden Center property is not great, the mine was rich and ore worth more than 100,000 ounces ($2,500,000) was taken from it before litigation forced a shut down. The Golden Center is currently idle. The deepest shaft is 1,900 feet (580 m) as measured along the incline (Bowen and Crippen, 1949).

SPRING HILL MINE (#233)

(SW Section 23)

The Spring Hill Mine (#233) northeast of Grass Valley is a small but promising operation which was active in 1949. It was one of the neatest, best maintained properties in the gold county and its headframe and mill have been photographed repeatedly for various publications. The main shaft is about 1,900 feet deep in diabase and serpentine wall rocks. The recorded production, most of which has been between 1928 and 1948, is 120,000 ounces (about $300,000; Bowen and Crippen, 1949).

1.0 Downtown Grass Valley. Turn right on Main Street east to Business Highway 49.

1.2 Stop sign. Go straight toward Nevada City.

1.6/0.0 Go under Highway 49 then take the on-ramp that curves to the right. Get on freeway, head north toward Nevada City. Reset odometer. To the east of the on-ramp is Idaho Maryland Road.

IDAHO-MARYLAND MINES (#232)

(NE Section 26)

Another major gold mining operation in Grass Valley active in 1949 was that carried on by the Idaho-Maryland Mines Corporation (#232). Its holdings include the Old Brunswick, New Brunswick, Idaho, and Eureka mines and many smaller workings. The New Brunswick shaft is 3,450 (1,050 m) feet deep and the Idaho is 2,700 feet (823 m) deep via shaft and winze. A successful attempt at shaft sinking by core drilling was made by the Idaho-Maryland. Part of the core can be seen at the Museum and in downtown Grass Valley. The Idaho No. 2 shaft was sunk 1,000 feet into serpentine by this method using a Newsom drilling machine developed at the Idaho-Maryland. The drill cores are five feet in diameter and weigh several tons each. Many of these cores were piled about the entrance to the shaft, but have since been removed. Although the Idaho-Maryland is not as large an operation as the Empire-Star, it is still among the six largest gold mines in California, and has a recorded production of 2,570,000 ounces (about $64,240,543). Ore-treatment plants at one time connected and served both the Idaho-Maryland and Empire-Star mines (Bowen and Crippen, 1949).

When the Idaho-Maryland closed, there were 40 mine working faces that had visible gold protruding from them at the time they were flooded. The Emperor Gold Company began dewatering the mine in 1998. When completed it plans to refurbish the access shaft and conduct an exploration program to study the feasibility of reopening the mine. Information about this project can be found at http://www.cityofgrassvalley.com/services/departments/cdd/IdMd/IS_09042007/IS_CH3_ALL_09042007.pdf (Oct. 20, 2008).

The project is proposed by Emgold Mining Corporation. Technical reports about it can be found on the company website: http://www.emgold.com/s/TechnicalReport.asp (Oct. 20, 2008).

Figure 39. New Brunswick ore bins and lumber, Idaho-Maryland Mine, 1977 (CGS Photo A7132).

Figure 40. Cores from the No. 2 shaft, 1000 foot-level cores, 1949 (CDMG photo).

Figure 41. Core samples, Idaho-Maryland mine exploration project, 2002. G. Wilkerson, M. Payne and D. Lawler.

Figure 42. Brunswick Mine, Idaho-Maryland Company, 1895 (CGS Photo A0855c).

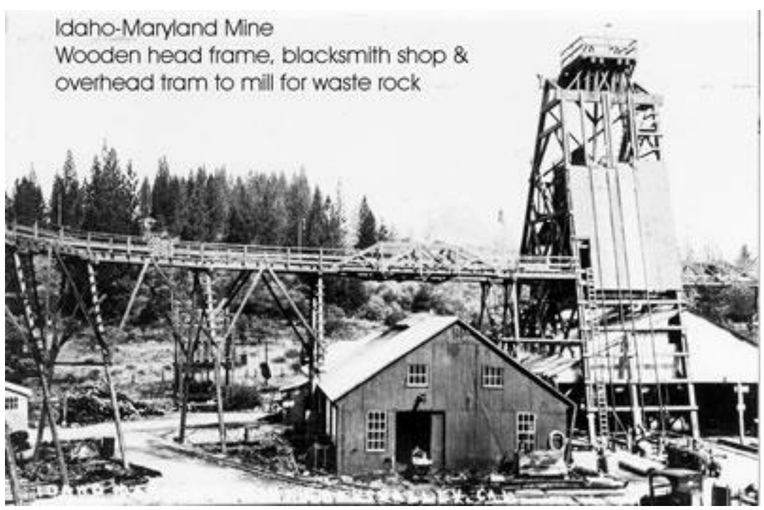


Figure 43. Idaho-Maryland Headframe

Figure 44. Idaho Maryland Mill Building.

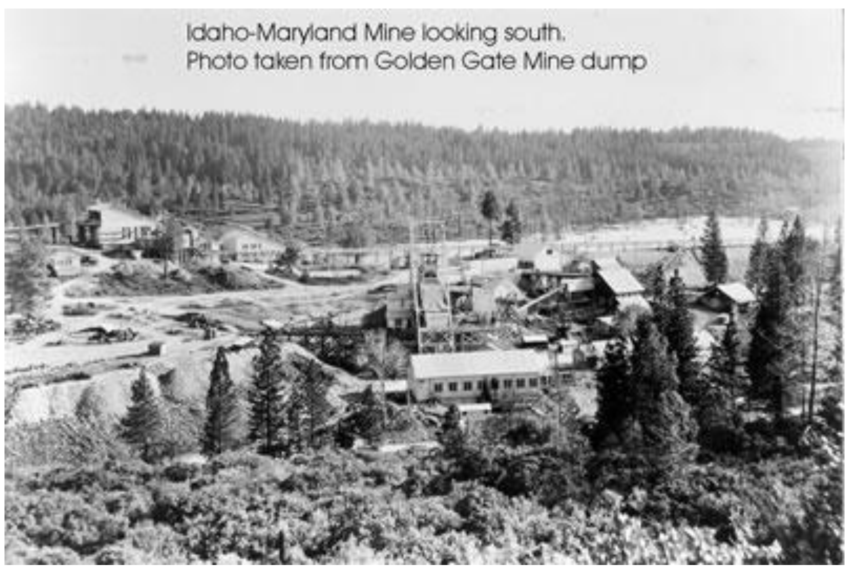


Figure 45. Idaho Maryland Mine.

Figure 46. Idaho Maryland Mine, skip with miners.

Figure 47. Idaho-Maryland mine cars.

Photo 8. Miners descended into the Idaho-Maryland mine in this man skip. The shaft entered the mine at a 72 degree angle and had a depth of 1500 feet; the descent took about 2 minutes. The man skip is now displayed at the North Star Mining Museum in Grass Valley. *Photo by Max Flanery.*

Figure 48. Miner's skip, Idaho-Maryland Mine (CGS, 1997:154).

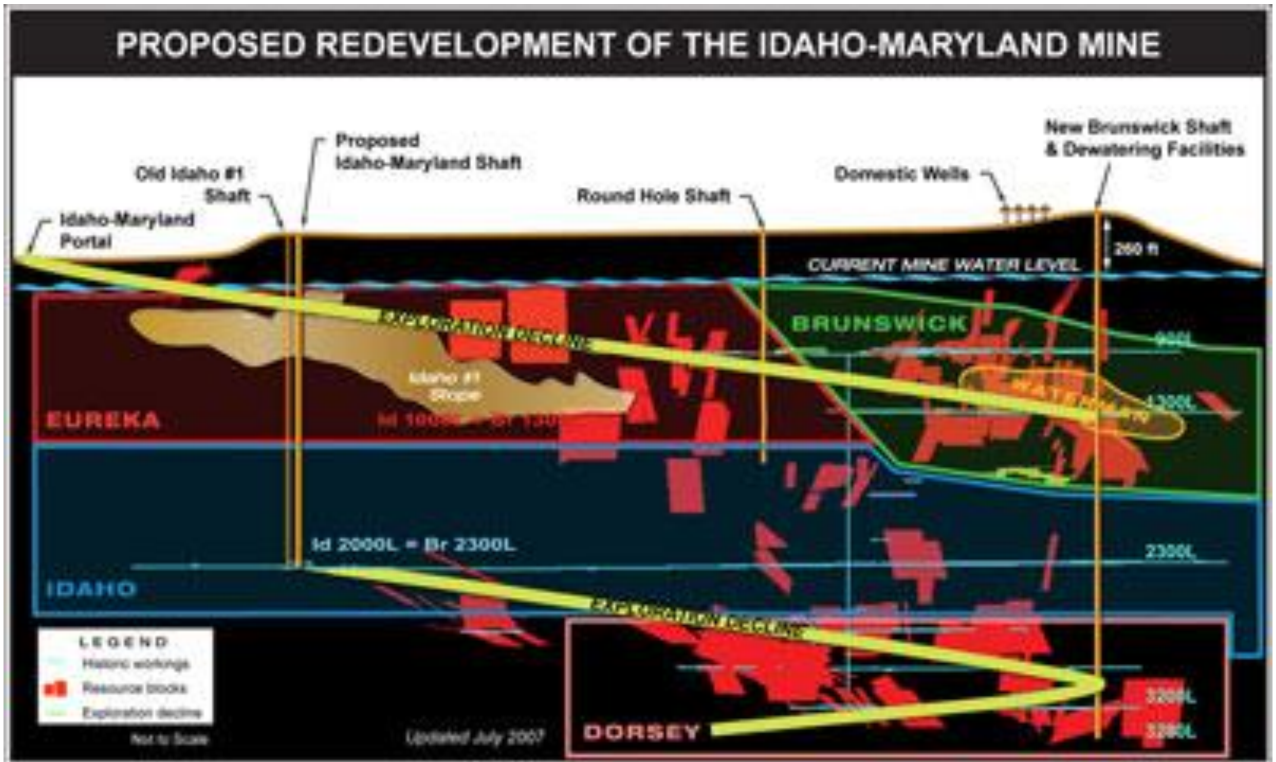


Figure 49. Proposed redevelopment cross section for the Idaho-Maryland Mine.

The following is taken from Emgold's web site and Technical Report for Project No. **U885A** Page 6-2 November 2002:

The original claim on the Idaho-Maryland property was staked in 1851. High-grade gold mineralization was discovered in 1861 with the commencement of mining in 1863. All production during this time was from a single vein referred to as the Idaho Number 1 Vein. Subsequent production from 1863 to 1893 produced 1.0 million ounces of gold from 1.0 million tons of ore. Fire destroyed the Idaho mine hoist in 1894, which caused the lower mine workings to flood. The period from 1894 to 1914 saw intermittent gold production (approximately 75,000 ounces).

The claims around the deposit were consolidated in 1915 to form the Idaho-Maryland mine. Metals Exploration Company of New York acquired control of the property, dewatered the mine, deepened the Idaho shaft to 2,000 ft (610 m) and moved the Union Hill stamp mill to the Idaho shaft area. Full production, however, was never achieved (only 27,000 ounces gold recovered). Control over the property changed in 1926 when Errol MacBoyle and Edwin Oliver created holdings that included the Idaho-Maryland, Brunswick, and Morehouse mines. Production commenced the same year.

From 1926 to 1942 the Idaho Mine produced 650,000 ounces of gold from 1.1 million tons of ore. The Brunswick Mine restarted production in 1934 after deepening its shaft to 3,460 ft and constructing a 750 t/d mill. Production from 1934 to 1955 consisted of 810,000 ounces of gold from 3.6 million tons of ore.

The mines were closed in 1942, due to the enactment of the Federal War Production Boards Limitation Order L-208, and were reopened again in 1945. Production was hampered by depleted operating funds, rising costs, skilled labor shortages, and negligible exploration and underground development work. Gold mining ceased in 1954, being briefly replaced by government-subsidized tungsten production until 1957. Mining activity stopped altogether in 1957.

At the time of closure, the mine was owned by Idaho-Maryland Industries, Inc. In 1963 Idaho-Maryland Industries executed a Quit Claim Deed to William and Marian Ghidotti. Ownership of the mineral rights eventually passed to Mary Bouma, Erica Erickson, and William Toms (referred to as the BET Group) in 1983. James Askew Associates, Inc (JAA) and Vector Engineering were commissioned in 1991 to examine all historic data preserved from past mining. The work produced an assessment report on mineral resources and exploration potential, rehabilitating the former workings and permitting requirements.

In 1993 Emgold, through its U.S. subsidiary Emperor Gold (U.S.) Corp, obtained a lease and option to purchase all mineral rights acquired by way of the 1963 Quit Claim Deed from Idaho-Maryland Industries, Inc. Over the next 7 years, approximately US$7 million was spent by Emgold to support work on the Idaho-Maryland property. The project was put on hold for approximately 1.5 years while the terms and conditions of the lease and option to purchase were renegotiated between Emgold and the BET Group. The revised Agreement includes a mining lease and option to purchase the Property, consisting of approximately 2,750 acres of minerals and mineral rights (with no surface rights), approximately 37 acres of land (referred to as the "Brunswick Property") with mineral rights located around the New Brunswick Shaft, and an additional parcel of 56 acres (referred to as the "BET Property") located west of the Brunswick Property. The term of the lease agreement is five years commencing on June 1, 2002.

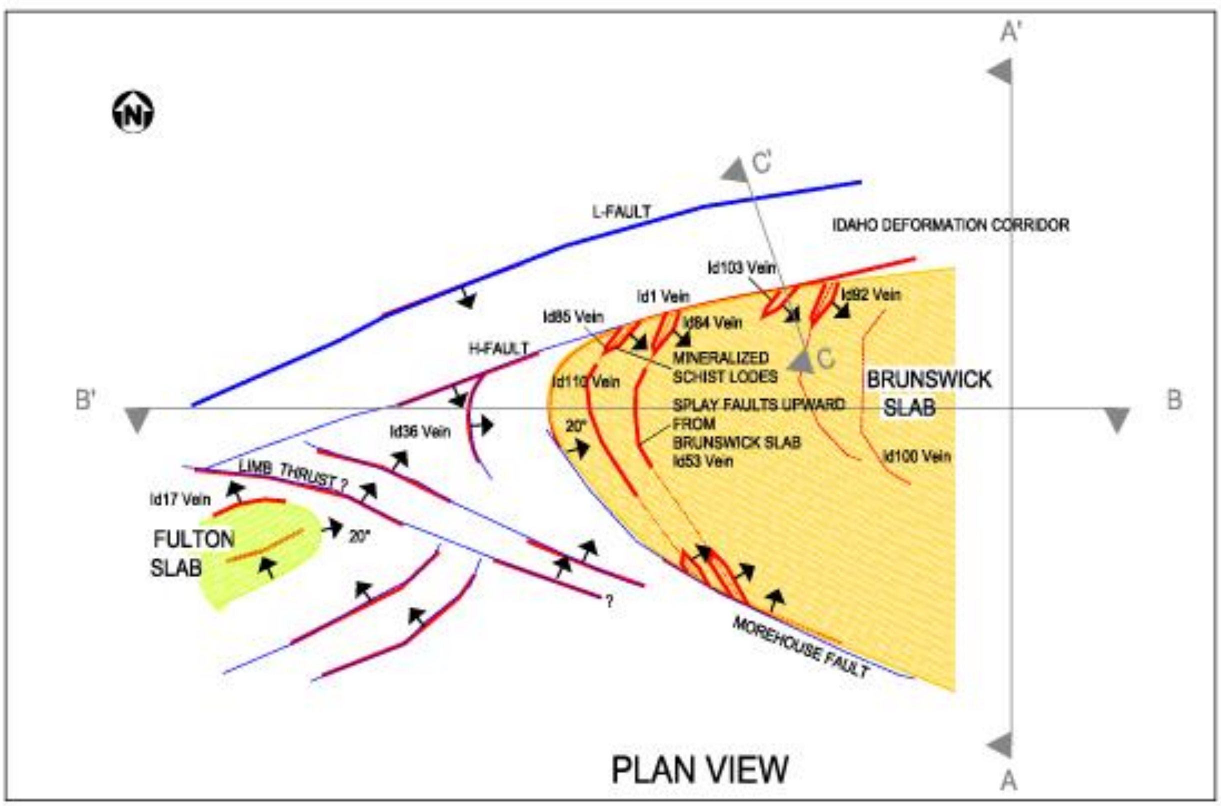
Geology

The Grass Valley Mining District within the Central Metamorphic Belt is laced by a braided system of first-order, right-lateral wrench faults that parallel the north-northwest regional structural grain. These wrench faults can be identified by the corridors of high strain and the discontinuous, linear bodies of ultramafic rock that intruded cold, upward along the deep-seated breaks. Individual wrench faults can be traced for up to 100 miles (160 km) in some cases, and they generally separate individual accreted terranes

Individual accreted terranes within the Central Belt are of diverse origin and composition. The terranes are comprised of thick Triassic to Jurassic submarine metavolcanic and meta-sedimentary accumulations deposited upon oceanic crust. The basement rocks were subsequently intruded by granodioritic to dioritic plutons that are satellitic to the main Sierra Nevada batholith. The individual terranes vary both in their degree of deformation and metamorphic grade. The regional metamorphic grade of individual terranes ranges from lower greenschist facies, to high-pressure, lowtemperature blueschist facies. The plutonic intrusions show little or no evidence of regional metamorphism or deformation.

In the Grass Valley area, the Central Belt is an 8 mile (13 km) wide north-trending assemblage hosting two discrete accreted terranes ranging from late Triassic to late Jurassic in age, intruded by two early Cretaceous plutons (Loyd et al, 1992; Saucedo et al, 1992). The Central Belt is bound on its west and east sides by regional-scale tectonic suture zones. The Wolf Creek Fault Zone bounds the western side of the Central Belt. The Wolf Creek Fault Zone ranges from 500 ft to 2,000 ft (150 m to 600 m) wide in the Grass Valley area and encloses tectonic mélange slabs of metasedimentary rock. The Gillis Hill Fault/Melones Fault bounds the eastern side of the Central Belt and can be traced for over 100 miles (160 km) southward where it hosts the famous Mother Lode Gold Belt.

Preliminary studies have demonstrated that the gold mineralizing event defining the Sierra Nevada Foothills Gold Belt appears to post-date peak regional metamorphism and intrusion of the Sierra Nevada batholith. The gold deposits are related to a poorly understood mid-Cretaceous deformation event that is isolated to the gold mineralized fault structures and overprints all previous deformations. The gold deposits of the Sierra Nevada Foothills Gold Belt are found in linear belts conspicuously associated with the network of deep-seated structures bounding and/or dissecting lithotectonic terranes.



Structural Setting

The Sierra Nevada Foothills Metamorphic Belt has a strong north-northwest-oriented structural grain. During the Jurassic Nevadan Orogeny, compression and horizontal shortening was directed east-northeast, imparting a strong structural grain to the region. The Nevadan Orogeny was a result of alternating periods of east-northeast lithospheric subduction of the Kula plate, and right-lateral, transcurrent-compressional strike-slip motion along transform faults in the North American plate. The unique geology along the western coast of North America is thought to be a product of this unusual oblique subduction (Schweickert, 1981).

There is evidence to indicate the subduction zone locked up periodically, and transpressional fault movement along a great number of deep-seated faults was the strain-releasing mechanism between the two colliding lithospheric plates. It is this system of deep-seated faults that has localized the gold deposits of the Sierra Nevada Foothills.

A minimum of three deformation episodes are recognized in the mining districts of the Sierra Foothills. The first is related to the alternating oblique subduction and transpressional faulting during the Nevadan Orogeny that generated north-northwest oriented isoclinal folding in the zones of high strain, and open-type folds in areas of lower strain. In the high-strain zones, a pervasive northwest-oriented axial planar cleavage was developed during that event. The second episode of deformation is related to the forceful intrusion of the composite Sierra Nevada batholith. The final episode is related to the gold mineralization events of the Sierra Nevada Foothills Gold Belt. This very limited third deformational event overprinted all high-strain zones, which are known to host gold deposits.

Brittle-ductile reactivation of these faults generated north-oriented crenulation folds and crenulation cleavage. Vein quartz was deposited in this stage. This poorly understood third episode resulted in cataclasis, attenuation, boudinage, and dismemberment of earlier quartz veins. Development of heavy fault gouge, reverse faults, and compressional telescoping has affected some vein structures as well.

The gold deposits in the Sierra Nevada Foothills are concentrated along numerous north to northwest-trending corridors of high strain related to second-order fault structures. The second-order faults branch from the first-order regional breaks that border the individual accreted terranes. Dilational jogs and pronounced bends in firstorder fault zones can be points where favorable second-order branch faults develop. Favorable second-order faults can also occur where rock competency contrasts develop pressure shadows adjacent to first-order faults. Many important gold deposits are located in third- and fourth-order faults, with poor mineralization occurring in the second-order structures. Dilational jogs, bends, and pressure shadows in or adjacent to second-order faults can yield favorable third- and fourth-order faults. At all scales, the corridors of high strain demonstrate a braided character, with high-strain zones encompassing lensoid or rhomboid domains of lesser strain.

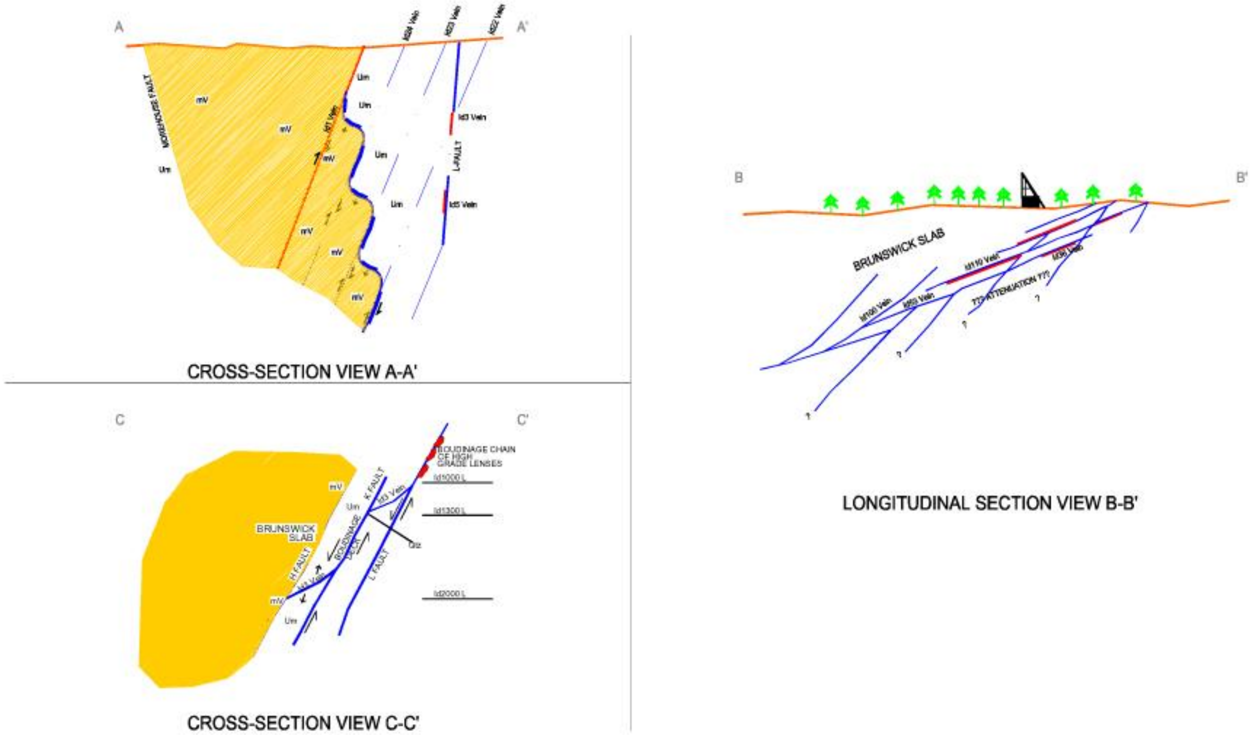
Property Geology

The rocks underlying the Idaho-Maryland Mine property are divisible into five separate units ranging in age from late Paleozoic to late Cretaceous:

1. Late Paleozoic to Triassic meta-sediments of the Fiddle Creek Complex
2. Jurassic meta-volcanics and interflow sediments of the Lake Combie Complex

3. Later Jurassic ophiolitic assemblage of the Spring Hill Tectonic Mélange
4. Discontinuous later Jurassic Tectonic Mélange of the Weimar Fault Zone
5. Early Cretaceous dioritic intrusives.

These are described in detail below



Fiddle Creek Complex

The Fiddle Creek Complex is a highly disrupted sedimentary and volcanic sequence that exhibits a higher degree of metamorphism than adjacent units. The Fiddle Creek Complex is comprised of a later Paleozoic to early Mesozoic submarine sedimentary prism atop highly deformed oceanic crustal rocks. The Fiddle Creek Complex outcrops east of the Weimar Fault as isolated windows of limited size eroded through the Peardale Nappe, in the lower plate of the Mount Olive Thrust Fault (Tuminas, 1983; Edelman et al, 1989; Loyd et al, 1990; Saucedo et al, 1992; and Payne, 2000).

The isolated outcrops of this sequence on the Idaho-Maryland property are tentatively correlated with the late Triassic Clipper Gap Formation, the uppermost unit of the Fiddle Creek Complex. This unit is poorly studied and its age is uncertain. Outcropping windows of Clipper Gap Formation immediately east of the Weimar Fault Zone are a highly disrupted assemblage of interbedded chert and argillite. The unit exhibits poorly developed stratification that has been tilted to near-vertical attitudes (Lindgren, 1896, p. 79). Locally, the chert-argillite sequence is interpreted to have been tectonically intermixed within a slate matrix to form a sediment-matrix tectonic mélange in a subduction complex (Tuminas, 1983).

The Clipper Gap Formation is best exposed underground in the 8 Crosscut on the Brunswick 1100 level, east of the Weimar Fault. The chert-argillite sequence is folded into a synform striking 300°. Black carbonaceous argillites dominate the sequence with interbedded dark gray chert, and minor beds of calcareous muddy sandstone (Farmin, March 1939b, June 1940b). Hard chert interbedded with sandstone and calcareous mud layers were encountered east of the Weimar Fault in the 13 Crosscut on the Idaho 1000 level (Farmin, July 1937a).

Lake Combie Complex

The Jurassic Lake Combie Complex is a thick meta-volcanic sequence with minor interflow meta-sediments. The unit is a rootless, dismembered sequence emplaced as thrust nappes in the upper plate of the Mount Olive Thrust Fault. The Peardale Nappe was emplaced east of the Weimar Fault. It is a regional-scale structural feature.

The upper plate of the Mount Olive Thrust Fault is mapped as the lower unit of the Lake Combie Complex. It is dominated by interbedded intermediate volcanic flows, flow breccias, and pyroclastic tuff breccias (Tuminas, 1983). The interflow sediments include carbonaceous slate, argillite, marl, and chert units. The interflow sedimentary units range from 3 to 330 ft (1 to 100 m) in thickness.

Spring Hill Tectonic Mélange

The late Jurassic Spring Hill Mélange comprises a chaotic assemblage of clasts dismembered from the Jurassic Lake Combie Complex and its underlying oceanic crustal basement. The Spring Hill Mélange was recently identified as a mappable lithotectonic unit in 1995 (Payne et al, 1997). It is a district-scale structure, which underlies a 4 mi2 (10 km2) area and dominates the property geology. The mélange unit is 4,200 ft (1.3 km) wide, extends for 4 miles (6.4 km) in a 300° orientation, and crosscuts the regional structural grain. The mélange is localized within a district-scale boudinage neck.

The Grass Valley Fault defines its southern margin. All of the significant gold production from the Idaho-Maryland Mine was localized within the matrix and tectonic slabs of this unit. The Spring Hill Mélange consists of serpentinized ultramafic rocks that contain a chaotic arrangement of tectonic clasts. The serpentinite matrix of the mélange is well foliated and highly deformed. Locally it is comprised of a talc schist or talc + chlorite schist assemblage. The tectonic clasts or fragments range from fist-size clasts to mega clasts up to 1.5 x 0.62 miles (2.4 x 1.0 km) in dimension. The clasts will be referred to as “slabs” when discussed individually in this report. The larger slabs have been named by the Emgold geologic staff. The tectonic clasts represent dismembered material from the walls of the intruded oceanic crustal sequence.

Individual tectonic slabs are monolithologic to heterolithologic in composition. The *Brunswick Slab* is the largest, bordering the Idaho Mine to the south, extending eastward for 1.5 miles (2,400 m), and encompassing the Brunswick and Union Hill Mine workings. The regional-scale Weimar Fault abruptly truncates the slab on its east end. The Brunswick Slab is a thick sequence of intermediate meta-volcanic flows, flow breccias, lesser tuffs, and minor interflow sedimentary units correlative with the Jurassic Lake Combie Complex. The interflow meta-sedimentary units include red to green cherts, black carbonaceous slates to wackes, and rare marl beds.

The Brunswick Slab hosts the Brunswick and Dorsey Vein Sets, and provides important controls for the Idaho and Morehouse Vein Sets. The *Maryland Slab* is elongated in a west-northwest orientation and outcrops in the Round Hole shaft area, directly east of the Brunswick Slab. The slab is predominantly

well-layered gabbro, locally massive, and of probable ophiolitic affinity. The mafic mineral content and grain size is quite variable. Faults form the sides of the layered gabbro slab. The Maryland Vein Set is localized beneath the keel of the shallowly southeast-plunging slab.

The *Fulton Slab* does not outcrop and was discovered on the Idaho 2000 level. The bottom of the shaft was sunk into the northeast contact of the slab. It is oriented in a N45°W direction, and lies 200 ft (60 m) northwest beyond the western terminus (keel) of the Brunswick Slab. A horizontal core hole penetrated a 650 ft (200 m) thick sequence of carbonaceous black slate to wacke with minor interbeds of black to grayfragmental meta-volcanics.

The Fulton and Morehouse Vein Sets are localized in, or adjacent to, the Fulton Slab. The *Sawmill Slab* is a large body that exhibits complex internal geology. The exact boundaries of the Sawmill Slab have not been determined due to poor exposure. This slab is located at the South Idaho shaft and outcrops prominently near the sawmill on East Bennett Street and along the low ridge bordering the south side of the Idaho tailings pond. The slab is composed of melanocratic to leucocratic layered gabbro cut by a sheeted diabasic dike swarm. These classic, sheeted dike structures are similar to those observed in layer 3 of oceanic crust. Ophiolitic sheeted dike structures include abundant one-sided chilled dike margins where later dikes have intruded up through the center of the previous dikes.

The *Sealy Slab* is a relatively small monolithologic clast of sheeted diabasic dike complex. It is worthy of mention due to its excellent outcrop exposure in a cut bank. It is the type area for the Spring Hill Mélange unit. Evidence of its ophiolitic affinity and faulted contact with the mélange matrix are nicely exposed. The Sealy Slab is located 300 ft (90 m) southward from the East Eureka shaft collar. Other lithologies represented in numerous smaller slabs include serpentinized peridotite, and a leucocratic diorite phase containing acicular hornblende needles

Tectonic Mélange – Weimar Fault Zone

The tectonic mélange of the Weimar Fault Zone is dominantly a highly deformed serpentinite matrix. Only one tectonic slab — the Green Slab — is recognized within the Weimar Fault Zone, a 330 ft (100 m) wide, intermediate meta-volcanic clast that was intersected in the 11 Crosscut on the Brunswick 1300 level. This slab does not outcrop, and is located due east from the New Brunswick Shaft.

Dioritic Intrusions

Minor dioritic intrusions are scattered across the Idaho-Maryland property, many of which are too small to map. The largest dioritic intrusion is a 1,300 x 900 ft (350 x275 m) mass underlying an isolated, ellipsoid-shaped hill in the far northern tip of the property, adjacent to the west of Brunswick Road. It intrudes the far northeastern portion of the Spring Hill Mélange unit. Another small, dark gray dioritic dike outcrops at Idaho-Maryland Road and extends southward onto the eastern edge of the Morehouse patented claim. It is fresh, unaltered, and undeformed. This dike is 13 ft (4 m) thick and contains abundant anhedral accessory pyrite.

Property Structural Geology

The shape of the Idaho-Maryland ore deposit is controlled by the regional-scale Weimar Fault and the district-scale Spring Hill Tectonic Mélange Zone. The tectonic mélange units of both major structural elements were discussed previously in the stratigraphy portion of this report. The Weimar Fault is a right-lateral wrench fault that transects an accreted terrane along its 50-mile (80-km) course. The fault cuts the late Paleozoic to Triassic Fiddle Creek Complex and an overlying nappe of Jurassic Lake Combie Complex rocks. It is a second-order fault that is younger age than the firstorder suture zones, which bound accreted terranes.

Weimar Fault Zone (6-3 Fault)

The Weimar Fault truncates all structures of the Idaho-Maryland Mine and forms the blunt eastern termination of the wedge-shaped ore deposit. The fault likewise truncates the eastern end of the Spring Hill Mélange unit. The Weimar Fault strikes 330° to 350°, dipping 70° NE through the eastern side of the property. It is poorly exposed due to the gouge and highly comminuted nature of the rocks within the fault zone. The surface trace of the Weimar Fault, near the New Brunswick Shaft, was a gougey serpentinite with the consistency of modeling clay (Jack Clark, Mine Superintendent from 1954-56, pers. comm., 1995). Clark further states that the Weimar Fault intersects the New Brunswick vertical shaft just above the 580 level station. He reports that the fault did not create any instability in the shaft, but that the shaft walls belled-out at that location where the rock broke to fractures. Underground, the Weimar Fault was intersected in many crosscuts and core holes. In all cases, the fault zone displayed strong shearing and gouge development.

Spring Hill Mélange

The Spring Hill Mélange unit (see Figure 7-3) is a dominant structural feature at the Idaho-Maryland Mine. A large portion of the mineral rights area is underlain by this unit. In the geological context of the Grass Valley Mining District, the Spring Hill Mélange and the Idaho-Maryland ore deposit cut the structural grain of the district at an obtuse angle. The Spring Hill Mélange unit is elongated in a 300° direction for 4 miles (6.4 km) and has an average width of 0.87 miles (1.4 km). It has a pervasive fabric plunging 20° SE at all scales. It is confined on its southern and northern boundaries by the Grass Valley and Olympia Faults, respectively. The matrix of the mélange is sheared serpentinite enclosing large exotic slabs of Jurassic Lake Combie Complex meta-volcanics and its underlying oceanic crust. The internal structural elements within the mélange control the locations of mineralization in the mine. Individual tectonic slabs have shown important controls localizing vein sets and the Idaho Deformation Corridor.

Idaho Deformation Corridor

The Idaho Deformation Corridor (Figures 7-3, 7-3a and 7-4) is a braided zone of high strain that extends along the entire length of the Idaho-Maryland ore deposit. The corridor averages 490 ft (150 m) in width and is traceable for 2.0 miles (3 km) along a 275° to 290° strike. The zone dips 60° to 70° south and extends to the deepest levels of the mine at 0.62 miles (1 km). The Brunswick Slab defines the southern boundary of the high-strain zone for nearly its entire length. The L Fault forms the northern boundary. In general, the zone exhibits a dominant normal vertical displacement with a much weaker component of right-lateral horizontal displacement. The Idaho Deformation Corridor is comprised of both linear and non-linear fault members. Both fault members show strong deformational fabric, well-developed gouges, and host the large, high-grade oreshoots of the mine. The linear faults include, from south to north, the Idaho, 89, H, and L Faults. Non-linear link faults include the Idaho 2 Vein, Idaho 4 Vein, Eureka, and Hammill Link Faults. The link faults are sigmoidal and trend northeasterly, dipping 20° to 40° SE. The link faults developed at points of dislocation along the contact of the Brunswick Slab. Large tabular plates of the slab were sheared off and displaced upwards along the planes of the linear fault members.

For example, at the Idaho 2000 level, the Idaho Fault follows the contact of the Brunswick Slab eastward from the area of the Idaho #1 Shaft to the area of the 30 Winze. It separates meta-volcanics of the Brunswick Tectonic Slab from serpentinite mélange matrix. Near the 30 Winze, the 70° S dipping Idaho Fault crosses the contact of the Brunswick Slab, slicing into it at an acute angle. From that point eastward, the Idaho Fault has meta-volcanics of the Brunswick Slab along its hanging and footwalls. At this same location, the Idaho 2 Vein extends from its junction with the Idaho Fault northeastward in a sigmoidal path. The Idaho 2 Vein now defines the contact between the meta-volcanics and serpentinites, with serpentinite at its footwall. The Idaho 2 Vein converges with the H Fault. The H Fault then defines the contact between the metavolcanic slab and the serpentinite mélange matrix eastward toward the Weimar Fault. In the above example, the linear fault members such as the Idaho and H Faults serve as the glide planes along which sheared plates of meta-volcanic rock slid upward. The link faults, such as the Idaho 2 Vein, are actually the preserved segments of the metavolcanic/serpentinite contact on the individual sheared plates. The ramp-like link faults may extend along their course upward through the serpentinites beyond the extent of the sheared plates of meta-volcanic slab. The points of dislocation marked by link faults along the contact of the Brunswick Slab are an important locus for the development of individual vein sets. The Maryland Vein Set is a prime example. The entire arrangement of faults and sheared plates of the Brunswick Slab suggest a fault duplex coupled with attenuation and incipient boudinage development.

Morehouse Fault

The Morehouse Fault (Figure 7-3) branches from the hanging wall of the Idaho Deformation Corridor and follows the footwall contact of the Brunswick Tectonic Slab in a great arc. The Morehouse Fault outcrops poorly and has received only minor development in the mine. Mine development at the keel of the Brunswick Slab on the Idaho 1500, 2000, and 2400 levels has suggested that dislocations may occur in a pattern along the bottom contact (keel) of the slab. This has been interpreted from the arrangement and orientation of veins within the Brunswick Slab (Dorsey Vein Set), and outside of the slab (Morehouse Vein Set). Ramp-like dislocations along the contact, with fault structures extending into the slab, may explain the development of isolated groups of veins within the Brunswick Slab in the deeper developments of the mine. Vein set development outside of the slab may be associated with the same fault structures extending outward into the serpentinites from the dislocation site. For example, at the Idaho 2000 level, the Idaho 110 Vein was developed in a 10° SE dipping fault plane within the Brunswick Slab. A new vein structure was encountered in the drift southward along the contact of the slab, localized at a point of dislocation in the slab contact. This new vein matches closely in orientation and attitude with the Idaho 110 Vein. It is worthy of note that the cross cut driven eastward into the slab connecting the Idaho 16 Vein hanging wall with the 110 Vein intersected a large body of mineralized rock. This mineralized body is described as a mass of quartz stringers cutting mineralized diabase. Assays from an interval of mineralized rock without quartz stringers yielded 0.19 oz/ton (6.5 g Au/t). The structural conditions at this location are presently unclear, but imply that large bodies of gold mineralization may exist in association with the Morehouse Fault. This target type warrants investigation.

The Brunswick 20 Series Faults

At the eastern end of the large Brunswick Slab, a series of dislocation planes called the 20 Faults occurs. The 20 Faults are sub-parallel to, and found within 1,000 ft (300 m) of, the Weimar Fault. The member faults dip steeply west to near-vertical. The individual faults converge into the Weimar Fault updip. Their course in plan view is 330° to 350° and they are notably sinuous. The 20 Faults cut the volcanic stratigraphy and Brunswick Vein Set at an obtuse angle. Relative displacement of individual Brunswick quartz veins bearing 275° to 290° is approximately 6.6 ft (2 m) in a rightlateral sense. Members of this family include the 20, 21, 21a, 21b, 22, and 23 Faults. The 20 series of faults exert locally important controls on oreshoots in the Brunswick Vein Set. The crossing of Brunswick Veins by members of the 20 Fault set can limit oreshoots in some cases, but is not a persistent feature in most areas of the Brunswick workings. The 20 Faults, in conjunction with a Brunswick vein crossing a bed of interflow graphitic meta-sediments, results in a black slate-type oreshoot of large dimensions. The Brunswick 7 and 12 Veins appear to be dragged and horse-tailed against one of these cross faults, resulting in 40 to 55 ft (12 to 16 m) wide quartz stringer zones. Adjacent Brunswick Veins are relatively unaffected in comparison.

The 20 Faults locally contain mineralized vein quartz in a similar fashion to that noted in the Weimar Fault.

The Brunswick Stacked Faults

At the northeastern corner of the Brunswick Tectonic Slab is a stacked series of shallowly northeast-dipping fault/veins. They are associated with the junction of the Weimar Fault and the Idaho Deformation Corridor and are most commonly found within 1,000 ft (300 m) of that wedge area. Well-known members of this vein/fault array are the Brunswick 4, 11, 34, 36, 41, and 48 Veins. Members of this fault set exert important controls on the location of exceptionally high-grade oreshoots and exceptionally large stockwork-veined deposits. Both deposit types occur where members or swarms of stacked faults disrupt the steep Brunswick Veins. Oreshoots in Brunswick veins will continue upward through an intersection of this type. It is consistently noted that strong gold mineralization will proliferate outward from the steep vein into the shallow dipping vein for distances of 50 to 100 ft (15 to 30 m) laterally. Where the arrangement of steep Brunswick veins is close, this can result in large areas of stockwork veining that mimic the shape of the flatter structures. The intersection of the shallow-dipping Brunswick 4 Vein with the steep 7 and 17 Veins resulted in a shallow-dipping stope 200 x 400 ft (60 x 120 m) in an area with a maximum true width of 50 ft.

MINERALIZATION

The veins consist primarily of quartz, which is milky white, massive to banded, sheared, and brecciated. Gold occurs as native gold, ranging from very fine grains within the quartz to leaves or sheets along fractures. Other constituents occur in minor to trace amounts and comprise calcite, sericite, mariposite, magnesite, and scheelite. Sulfide minerals are ubiquitous in the quartz veins (1 to 4 visual percent) and consist primarily of pyrite. Galena, chalcopyrite, and various tellurides are present in trace concentrations. Sphalerite and arsenopyrite are only rarely observed. The varying styles of mineralization present at the Idaho-Maryland Project are typical of those commonly found in mesothermal lode gold deposits worldwide. At least four basic types of mineralization have been recognized to contain significant gold deposits. In order of importance, these include (1) gold-quartz veins, (2) mineralized black slate bodies, (3) mineralized diabasic slabs, and (4) altered, mineralized ultramafic schists. These are discussed in more detail below.

Gold-Quartz Veins
Quartz Veins & Immediate Wallrocks

Quartz veins and their immediate wallrocks (Figures 7-3 and 8-1) have produced over 80% of the gold at the Idaho-Maryland Mine. The gold-bearing quartz veins are structurally complex, strike in all compass directions, and have attitudes that range from horizontal to vertical. The economic veins ranged from 1 to 25 ft (0.3 to 7.6 m) in thickness. The largest vein ore shoot was 650 ft (200 m) in vertical extent and plunged continuously at a shallow angle for 5,600 ft (1.7 km). The morphology of the veins varied from tabular veins and stringer zones, to oblique-extension veins exhibiting exotic centipede structures. The veins are generally tabular,ribboned to massive quartz, and contain minor gangue and accessory minerals. Vein gangue includes minor carbonate phases along selvages (ankerite, calcite, dolomite, and ferrodolomite), sericite, chlorite, and albite. Pyrite is by far the dominant accessory mineral, constituting 1% to 2% of the ore. The mineralized, schistose vein wallrock commonly constituted ore, locally up to 10 ft (3 m) into either or both walls of the vein. The gold-bearing wallrocks contained large quantities of carbonate, with lesser sericite, chlorite, and albite. Accessory pyrite was reported in the wallrocks at similar concentrations to those found in the vein. Gold tenor of the quartz vein ores ranged from 0.10 to 10.00 oz/ton (3 to 350 g/t) for individual stopes.

Large Quartz Stockwork Vein Deposits

Partial mining of a large quartz stockwork vein deposit accounted for 1.5% of total gold production from the Idaho-Maryland Mine. This large resource was delineated in the late 1940s and remains unexploited. This type of mineralization consists of a reticulated mass of steep and shallowly dipping quartz veins and veinlets. Vein quartz constitutes 20% to 80% of the mineralized rock by volume. The overall shape of the zone mimics the orientation of the shallowly dipping veins in the set. The dimensions of this body are 250 ft (75 m) in strike length, 950 ft (290 m) in dip length, with an average true thickness of 75 ft (23 m). The maximum true thickness is 122 ft (37 m). The quartz stockwork veined mineralization shares common characteristics with the other Idaho-Maryland mineralization types. The intermediate meta-volcanic host rocks are bleached and pervasively ankerite + sericite + chlorite + pyrite altered. A minor quantity of disseminated pyrite was the only accessory mineral reported. Coarse particulate free gold was present, but occurred less frequently in stockwork ores compared to all other mineralization types. Gold tenor for stockwork veined material is in the range of 0.10 to 0.20 oz/ton (3 to 7 g/t). The stockwork zone had irregular walls that were determined visually by the degree of shattering and the intensity of subsequent vein filling. The primary control for stockwork veined bodies was related to bends in the plane of the adjacent Weimar Fault. Shattering was directed into the brittle meta-volcanic wallrock at these locations.

Tensional Vein Arrays

Tensional vein arrays localized in wedge areas between intersecting faults have contributed an unknown percentage of the gold production at the mine. Stacked arrays of shallow-dipping quartz veins can constitute large, potentially bulk mineable deposits. Known examples have plan dimensions of (50 x 50 ft to 50 x 220 ft (15 m x 15 m to 15 m x 70 m), with the down rake projection being the long axis of the deposits. An extreme example is the mineralized wedge at the Id2 Vein to Id3 Vein junction, which has been documented on seven mine levels from the Idaho 1600 to 3000 levels, this suggesting a rake length of over 3,300 ft (1,000 m). Other examples include mineralized wedges at the following functions: Id3 Vein to Id25 Vein, Idaho Fault–L Fault, Br9 Vein to Br10 Vein, Br2 Vein to Br6 Vein, and Br2 Vein to Br32 Vein. The ore minerals, gangue minerals, accessory minerals, and alteration types are all similar to those described for the stockwork vein mineralization type, and coarse free gold is noted as is customary in all mineralization types at the mine. Expected gold tenor of mineralized wedge ores is in the range of 0.10 to 0.40 oz/ton (3 to 14 g/t). Visual estimation of vein density determines the boundaries. Variations in the plunge inclination have been assumed to control the fracture intensity and economic boundaries.

Mineralized Black Slate Deposits

Graphitic black slate bodies (see Figure 9-1) have produced approximately 5% of the gold at the Idaho-Maryland Mine. The mineralized black slate bodies develop exclusively out into the hanging wall of a tabular quartz vein, coincident with an important set of northwest-trending, steeply dipping cross faults. Three known mineralized slate bodies range from 20 to 100 ft (6 to 30 m) in thickness and constitute large bulk-mineable oreshoots in the mine. The maximum dimensions are 300 ft (90 m) in vertical height and horizontal length. Very coarse gold is contained within a stacked array of highly graphitic flat fault planes of 0.2" to 2.0" (0.5 to 5 cm) thick, flat quartz veinlets that cut the steeply dipping meta-sediments. The host rock ranges from slate to medium-grained wacke. The only reported gangue minerals were heavy amounts of graphite and trace vein carbonate. Accessory fine-grained pyrite occurred in minor amounts up to 1%. The ore mineral was coarse particulate free gold. Flat plates up to 3" x 4" (5 x 10 cm) in dimension without vein quartz were found puddled in low spots along highly graphitic flat planes. The gold tenor of this ore averaged 0.20 to 0.25 oz/ton (7 to 9 g/t). Past employees have indicated that simple screening of the +6" (+15 cm) fraction would have doubled the millhead grade of this material. Mill records indicate that recoveries of gold from black slate ores averaged 80%, the highest for all the mineralization types.

Mineralized Diabasic Slabs

Mineralized diabasic slabs (see Figure 8-1) have produced approximately 3% of the gold mined from the Idaho-Maryland deposit. The mineralized diabasic bodies are foliated, folded, and deformed mélange slabs that have no predictable occurrence within the mine. They were generally discovered in exploratory core drilling and crosscuts. Mineralized diabasic slabs range from 3 to 36 ft (1 to 11 m) in thickness, with a maximum length of 400 ft (120 m) measured along the shallow plunge of the body. Stringer zones of quartz veinlets can constitute up to 10% of the volume. Gangue minerals included abundant carbonate phases, chlorite, and sericite. Euhedral cubic pyrite was the only reported accessory mineral, and gold was the only ore mineral. The gold tenor of mineralized diabase was 0.20 to 1.0 oz/ton (7 to 35 g/t) for individual bodies. Gold recoveries were reported to be similar to those for the quartz vein ores

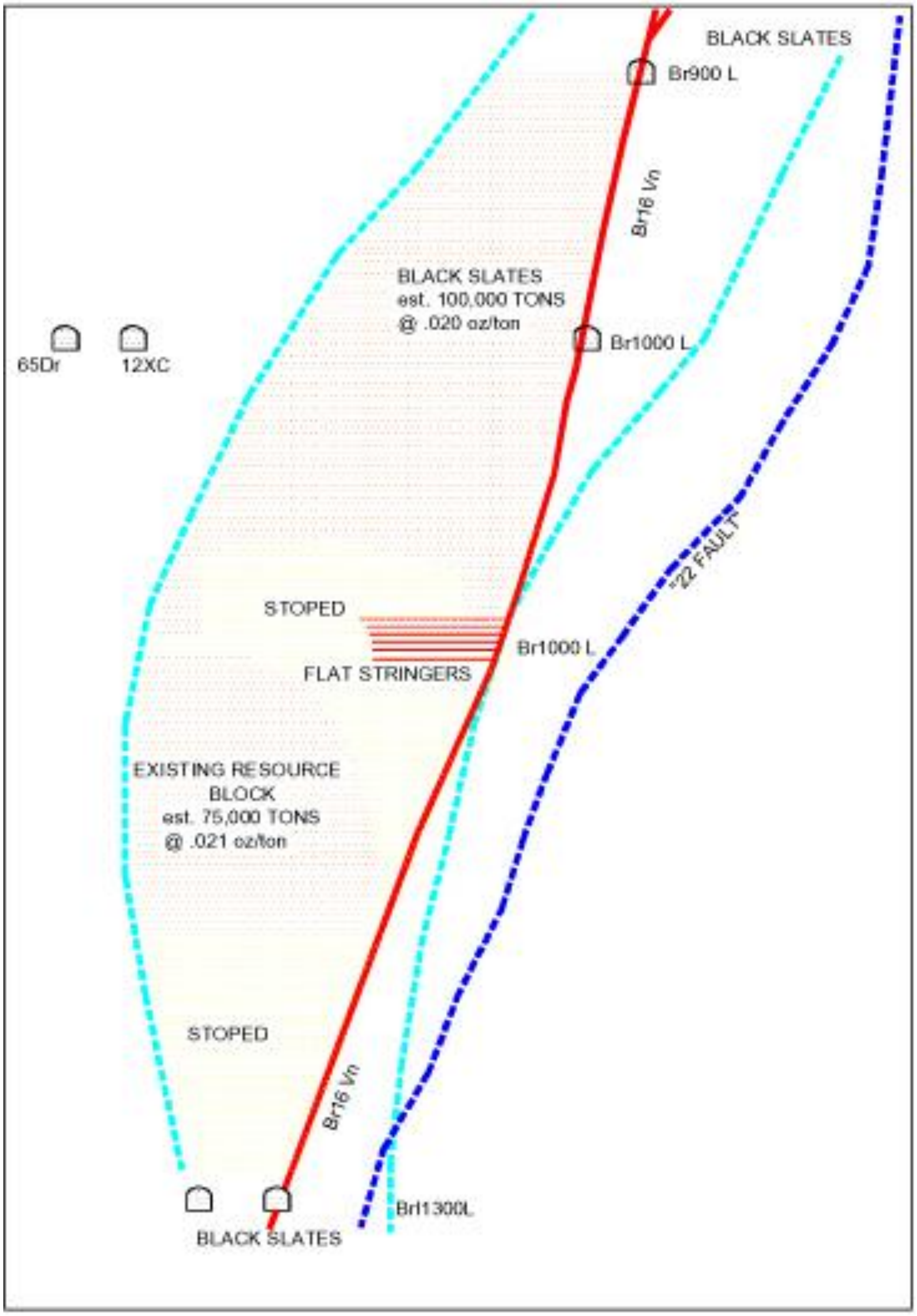


Figure 50. Diagramatic cross section of deposit types, Idaho-Maryland Mine.

Mineralized Ankerite or Talc Schists

Mineralized ankerite or talc schists (Figure 7-3) that developed along shear zones have produced less than 1% of the gold at the Idaho-Maryland deposit. They were hosted in an altered ultramafic mélange matrix and in altered intermediate meta-volcanics of mélange slabs. At the Idaho 2000 level, the Idaho 3 Vein showed rapid gradation from a vein quartz lode to a mineralized schist lode, with stringer zones of quartz veinlets constituting 0% to 10% of the volume. Gangue minerals included abundant talc or carbonate, and the lone accessory mineral was disseminated pyrite. Free gold, found along foliation planes, was the only ore mineral produced. The gold tenor of the mineralized schists averaged 0.10 to 1.0 oz/ton (3 to 35 g/t) in individual stopes.

0.9 Brunswick Avenue exit to Town Talk.

TOWN TALK (#235)

(S1/2 Section 13)

Midway between Grass Valley and Nevada City was the old mining camp of Town Talk (#235). Little remains to mark the site because it has been overrun by urban development of Grass Valley. Historian Glasscock has it that Town Talk came about partly as an act of God and partly as a practical joke. An old saloon sign bearing the words Town Talk is supposed to have been stranded in the vicinity of the camp by flood waters of Deer Creek. Someone fished the sign out and stuck it up on the hill and the camp was thereafter known by that name.

2.0 Gold Flat Road.

2.6 Nevada City limits (#236).

3.1 Broad Street exit. Take this to the South Yuba Canal Office with its display of 5-stamp mill, water wheel and 5-foot diameter drill core of serpentine gabbro. Then turn left, go west into Nevada City.

NEVADA CITY (#236-237)

3.3 Downtown Nevada City

Nevada City, four miles northeast of Grass Valley, has been a famous lode-gold mining center although the mines there are currently idle. James Marshall passed through here seeking a placer bonanza in the summer of 1848 but missed making a strike. The first settlers arrived in 1849 and the placers attracted a large population within a few months. Known originally as Coyoteville, because of the local method of tunneling called coyoteing, the name Nevada City was evolved after a dispute with the state of Nevada over priority rights to that name. A total of 320,000 ounces ($8,000,000) in placer gold is said to have taken from the vicinity. Nevada City is county seat of Nevada County and, like Grass Valley, is full of pioneer landmarks such as the Wells-Fargo Express Office site established in 1853, fire-houses built in the 1869's and a remnant of Chinatown. It is situated on Highway 20, which connects with Reno and, like Grass Valley, was once connected to the transcontinental rail route of the Southern Pacific (Bowen and Crippen, 1949).

Figure 51. Champion Mine circa 1890, CGS Photo A7175.

Figure 52. Nevada City circa 1900, CGS Photo C6572.

Figure 53. Nevada City Firehouse, CDMG Bull 141, photo 141-159.

Figure 54. Nevada City stone brewery, Sacramento Street. CDMG Bull 141, p. 141-158

The principal lode mines of Nevada City are the Lava Cap, Murchie, Champion, and Providence. The Nevada City assay office is credited with assaying the first ore taken from the Comstock lode (Bowen and Crippen, 1949). Nevada City is underlain by Jurassic granodiorite.

3.4 Hydraulic workings on Cement Hill Ridge along skyline at the 12:00 o'clock position.

3.5 Pioneer Park on right.

3.5 Broad Street exit with granodiorite exposed in roadcut.

3.6 Street splits at "Y". Stay to the left on Broad Street.

3.8 **Nevada City cemetery (#237)**.

5.0 Hydraulic diggings on right (north) on south flank of Cement Ridge.

LAVA CAP (#358), MURCHIE, CHAMPION AND PROVIDENCE MINES

The Lava Cap Mine (#358) is 3.6 miles east of the Empire mine in T. 16N, R.9E, Section 28 on Lower Banner Road. It has a recent history dating from 1933. In its ten years of operation it grossed about 360,000 ounces gold and 40,000 ounces silver ($12,000,000). The mine is 2,700 feet deep and has over five miles of lateral workings. The Murchie was worked in a small way in the 1890's but major production took place in the 1930's. The mine is now owned by the successors of the Empire Star Mines Company, Ltd., and is currently idle. It was an exceedingly productive mine before the World War II, but few figures on it are available. The Champion and Providence mines have been worked discontinuously, with indifferent success, since the early day lode-mining period of the 1860's and 1870's. The Nevada City mines lie at the fringe of the Grass Valley district and the ore shoots have not persisted at depth as have those in the heart of the district (Bowen and Crippen, 1949).

The Lava Cap mine became a Superfund Cleanup site in 1997. The site is on private land and you must have permission to enter the property. The EPA website for this mine is:

(http://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/vwsoalphabetic/Lava+Cap+Mine?OpenDocument, Aug. 3, 2008).

The following is taken from the EPA website:

The Lava Cap Mine site occupies approximately 33 acres in a semi-rural residential area of the Sierra Nevada foothills in western Nevada County, California. The site is approximately 5 miles southeast of Nevada City and 6 miles east of Grass Valley at an elevation of about 2700 feet. The site includes the mining area where ore was processed to recover gold, and areas where tailings which originated at the mine have been washed downstream and deposited over time. The downstream areas of the site include Lost Lake, a private lake surrounded by homes, located approximately 1-1/4 miles downstream of the Lava Cap mine site.

In 1994, an estimated 1,776 people lived within one mile of the site, and 24,091 lived within four miles of the site. The immediate watershed basin ecosystem contains two California Species-of-Special-Interest: foothill yellow-legged frog and western pond turtle, in addition to more common species of reptiles, amphibians, fish, birds, and mammals.

Gold and silver mining activities were initiated at Lava Cap Mine in 1861. From 1861 to 1918, processing of the ore and disposal of the waste rock, overburden, and tailings occurred off-site at the Banner Mine, which is located approximately 1.5 miles north of the Lava Cap Mine.

The Lava Cap Mine was inactive from 1918 to 1934, at which time mining activities were resumed and a flotation plant was built to process the ore at the site. The gold and silver concentrates from the flotation plant were shipped to two smelters, one in California and the other in Washington. In 1940, a cyanide plant was built to recover the concentrates on site. However, this operation proved to be relatively ineffective. From 1941 to 1943, the cyanide plant only handled the middlings and tailings from the flotation plant. The middlings and tailings were ground to a very fine size (i.e., able to pass through a 400-mesh screen) then vat leached with cyanide to remove the residual gold and silver. Slurries from the flotation and cyanide processes were deposited in a ravine on the site. Where the ravine steepened and narrowed, a log dam approximately 60 feet high was built to hold the tailings in place. The waste rock and overburden were also deposited in two piles located at the site between the mineshaft and the tailings pond. In 1943, Lava Cap Mine was closed due to World War II. An attempt was made to re-open the mine in the mid-1980s. However, community opposition resulted in the defeat of a proposed rezoning of the property which would have allowed mining activities to resume at the site.

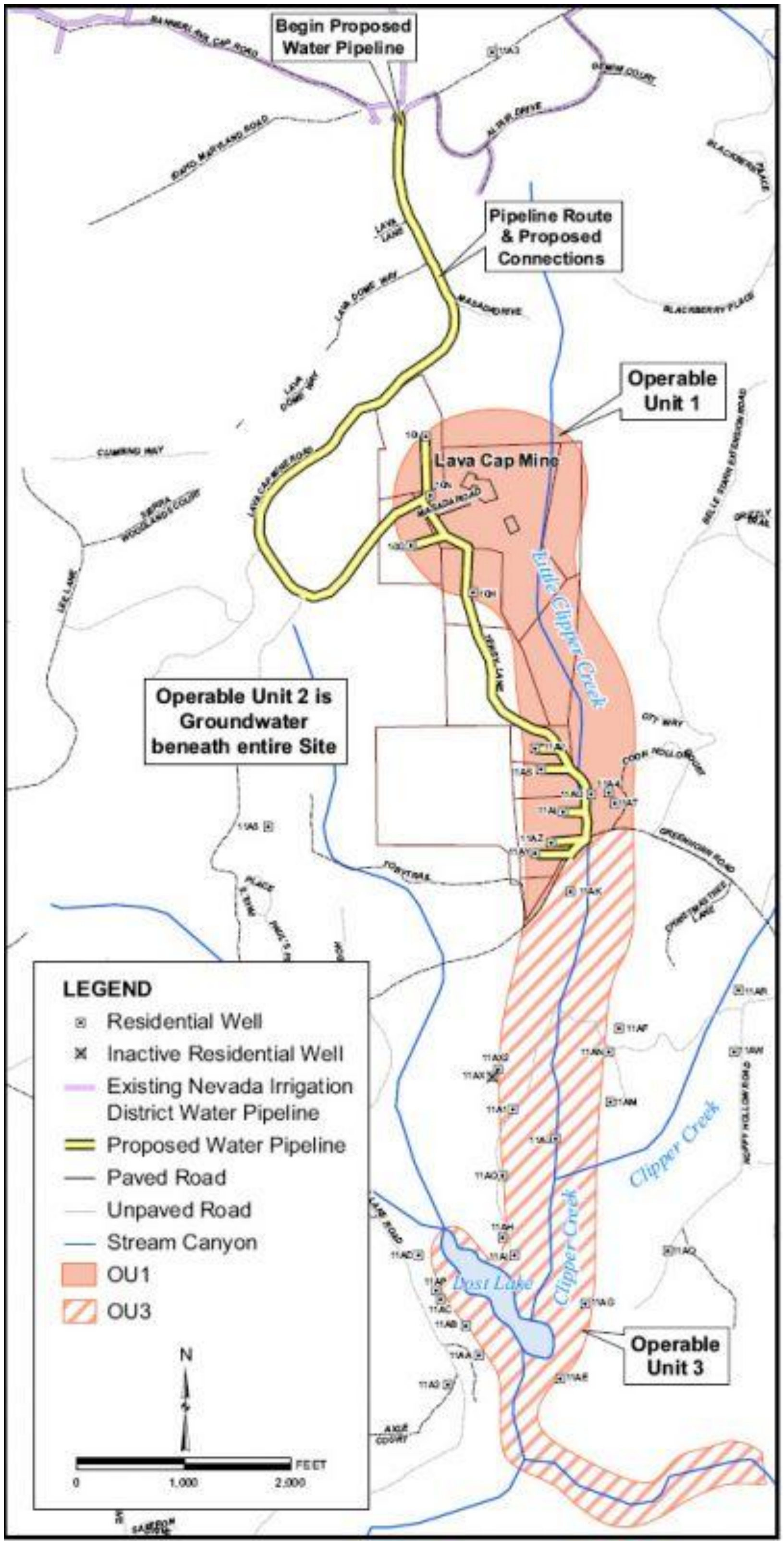
In 1979, complaints from local residents initiated an action from California’s Central Valley Regional Water Quality Control Board (RWQCB) that led to issuance of a Cleanup and Abatement Order (CAO). The CAO called for the property owners at that time to take measures to limit tailings discharges to Little Clipper Creek, to divert surface water runoff from the mine and mill waste fill deposits, and to obtain an evaluation of the dam. This Order resulted in the construction of three small settling basins below the dam and some flow diversions around the tailings. No improvements were made to the dam.

During a major winter storm in January 1997, the upper half of the log dam collapsed, releasing over 10,000 cubic yards of tailings into Little Clipper Creek. In early 1997 staff from the California Department of Fish and Game and the Nevada County Department of Environmental Health inspected the site. Extensive deposits of tailings were observed in and on the shoreline of Little Clipper Creek, at the confluence of Little Clipper and Clipper Creeks, and in and on the shoreline of Lost Lake. The tailings were also observed in wetland areas contiguous with these water bodies, in some cases completely covering the vegetation.

Several times during 1997, DTSC has conducted sampling at the mine site and off-site at Lava Cap Mine to determine the locations and concentrations of arsenic contamination. Following the dam collapse in January 1997, the current property owner constructed a drainage ditch upstream of the mill tailings which partially diverted surface away around the tailings.

The EPA formally listed the Lava Cap Mine site on the National Priorities List (NPL) in February 1999, allowing Superfund funding to be spent on investigation and cleanup of the site. In 2004, as a result of initial studies of the site, EPA divided site into three project areas, or Operable Units. The three are:

- Operable Unit 1, the Mine Area
- Operable Unit 2, Groundwater
- Operable Unit 3, the Lost Lake area
- Operable Unit 4, Mine Area Residences



Begin Proposed Water Pipeline
Pipeline Route & Proposed Connections
Operable Unit 1
Lava Cap Mine
Little Clipper Creek
Operable Unit 2 is Groundwater beneath entire Site
Clipper Creek
Lost Lake
Operable Unit 3
LEGEND
Residential Well
Inactive Residential Well
Existing Nevada Irrigation District Water Pipeline
Proposed Water Pipeline
Paved Road
Unpaved Road
Stream Canyon
OU1
OU3
N
FEET
0
1,000
2,000

GEOLOGY WEST OF NEVADA CITY

West from Nevada City, Highway 49 passes through a thick series of Tertiary gravels which lie at the southern base of a ridge of rhyolite tuff and andesite. These deposits have been extensively hydraulicked and placered. Hydraulic pits and faces of moderate size can be seen on both sides of the highway. West of the gravels the granodiorite outcrops are full of dark inclusions or enclaves. These vary in size from fractions of an inch to one foot in diameter. Enclaves are common in many granitic batholiths and are formed either by magmatic segregation of various mineral constituents by inclusion and partial assimilation of wall rocks caught in the invading magma. In most cases they carry a greater proportion of dark minerals than the matrix rock and have a somewhat different pyrite. Pyrite occurs only in the enclaves, not in the matrix rock, and probably was a constituent of the assimilated rock from which the enclaves formed. The texture is granitic but the crystals are finer than those in the matrix rock, which is essentially a biotite-hornblende granodiorite. Excellent exposures of these rocks may be seen in roadcuts 1.2 miles west of Nevada City (Bowen and Crippen, 1949).

Immediately west of the enclave locality is the contact between the Jurassic granodiorite and metavolcanic greenstones. Lindgren's map shows these to be in the Calaveras Formation but separate from greenstones lying a quarter of a mile to the west. Two miles farther to the northwest is a narrow belt of serpentine and related basic intrusive rocks which are not particularly well exposed along the highway except in deeply weathered roadcuts. Deeply weathered areas and dark red soil mark remnants of the old Eocene surface. The remainder of the route into North San Juan lies on a granitic bedrock ranging in composition from quartz diorite to granodiorite. A small roof pendant or remnant of overlying wall rock of dark green amphibolite can be seen in road cuts 1.2 miles south of the Yuba River bridge. The greenstone is cut by aplite and pegmatite dikes. A good locality for collecting hornblende crystals is to be seen close to the amphibolite contact (Bowen and Crippen, 1949).

7.9/0.0 Cement Hill Road and Highway 49. Reset odometer.

SIDE TRIP TO EDWARDS CROSSING, MALAKOFF DIGGINS, SAN JUAN RIDGE AND CHEROKEE

A description of the geology along Highway 49 between Nevada City and Peterson's Corner (Tyler Foote Road) is resumed on GEOLOGY MAP 37. To explore this side trip to Malakoff Diggins, turn right and go east on Highway 49 past the County Government Center to North Bloomfield Road.

0.4 North Bloomfield Road and Highway 49. Turn left, go north past the California Division of Forestry station.

0.7 Cement Hill Tertiary tributary channel gravels and red soil.

0.9 North Bloomfield and Lake Road "T" shaped intersection. Turn right, go east on North Bloomfield Road. **Sugarloaf Mountain (#238)** , to the west is capped by Miocene-Pliocene andesitic pyroclastic rocks of the Mehrten Formation. Below the Mehrten, locally, are Tertiary "auriferous" gravels. These rocks are exposed in roadcuts along the north flank of Harmony Ridge.

1.5 Tertiary Mehrten mudflow outcrops on right.

GEOLOGY MAP 37

Nevada City to Kennebeck Creek

(Saucedo and Wagner, 1992; Yeend, 1974; Hacker, 1984)

3.2 Normandie Mine to left (north).

3.3 Hoge Mine to the right.

4.3 Old narrow concrete bridge over Rock Creek. This creek cuts through Mehrten Formation into Tertiary gravels. To the southwest (south of Rock Creek and west of the roadway) is a small outcrop of Mesozoic-Paleozoic metasedimentary rocks of the Central Belt.

NORTHERN MOTHER LODE STRATIGRAPHY

The Chico Sheet for the State Geologic Map (Saucedo and Wagner, 1992), identifies three metamorphic-plutonic belts in this part of the Mother Lode. The Western Belt includes rocks of the Smartville Complex that lie west of the Big Bend-Wolf Creek Fault Zone. The Central Belt lies between the Big Bend-Wolf Creek Fault and the Melones Fault Zone. It has rocks of the Slate Creek Complex and Lake Combie Complex. Along the east side of the Central Belt, between the Ramshorn and Goodyears Bar Faults, is the Fearther River Peridotite Belt. The Eastern Belt is east of the Melones Fault Zone and has Shoo Fly Complex and Calaveras Complex rocks as well as granodiorite-granite plutons and Tertiary volcanic units.

The Smartville, Slate Creek, Lake Combie, Feather River, Shoo Fly and Calaveras Compexes are tectono-stratigraphic units of similar (but not identical) age. They are separate terrane blocks representing material from different parts of the ancestral Pacific Ocean which subducted and accreated to the North American Craton from Triassic to Miocene time.

The Big Bend-Wolk Creek Fault Zone merges into the Bear Valley Fault south of Auburn. The Melones continues southward through the mining districts of Greenville, Garden Valley, Placerville, Plymoth, Amador, Sutter Creek, Jackson, Carson Hill, Jamestown, Coulterville and Mariposa.

4.7 Blue Tent School Road. This area is underlain by Miocene-Pliocene andesitic pyroclastic rocks of the Valley Springs Formation. This unit is in the Fiddle Creek Terrain of the Central Belt.

4.8 Road on right goes to **Sailor Flat (#239).**

6.4 Diamond Arrow Center Conference Grounds, formerly Kirkham Ranch (#240). From here a windy road goes down to Edwards Crossing. The road also becomes a single-lane.

6.9 South Yuba Recreational Area boundary sign.

7.4 Granodiorite exposures in roadcuts.

7.7 Site of historic stage coach robbery.

EDWARDS CROSSING (#241)

8.0/0.0 Edwards Crossing.

Edwards Crossing is a popular recreational site on the South Yuba River. The area is good place for gold panning. Suction dredging is popular in this and several other Mother Lode rivers. Rocks are basic intrusives with Mesozoic-Paleozoic metasediments of the Fiddle Creek Terrain of the Central Belt. East Belt rocks are to the north.

Enormous amounts of hydraulic tailings were deposited along this stretch of the Yuba River. The tailings extended from this bridge to Malakoff Diggings several mines to the east. In some places these tailings were over 150 feet thick and completely choked the river channel. The main southern tributary of the Ancestral Yuba River crosses present canyon of the South Fork of the Yuba River 1 to 2 miles upstream from Edwards Crossing (Bowen and Crippen, 1949).

Cross the bridge and proceed east toward Malakoff Diggins on dirt road.

0.5 Caved adit (tunnel) on the left.

0.6 Mezozoic-Paleozoic metasedimentary marine rocks of the Fiddle Creek Terrain of the Central Belt in roadcuts (MzPz on state map).

1.5/0.0 Junction of the Grizzly Hill Road and North Bloomfield Road. Turn right on North Bloomfield Road. Reset odometer. This area is underlain by Tertiary gravels.

0.2 South Yuba Trail and camp on the right.

0.8 Slaty cleavage in MzPz unit metamorphic rocks. These are “Undifferentiated Lake Combie and Slate Creek” rocks of Saucedo and Wagner (1992). In USGS Open File Report 2001-229 they are shown as Fiddle Creek Terrain of the Central Belt.

0.9 **Kenebec Creek (#359)** in Paleozoic metasediments.

1.6 Red soils representing deep Eocene weathering.

GEOLOGY MAP 38

Kennebeck Creek to San Juan Ridge
via Malakoff Digggins and North Bloomfield
(Saucedo and Wagner, 1992; Yeend, 1974; Hacker, 1984)

2.0 Cross lithologic contact between Fiddle Creek Terrain of the Central Belt metasediments and overlying Miocene-Pliocene Mehrten andesitic pyroclastic rocks.

2.4 Lake City historic townsite (circa 1860-1880). This area is underlain by Mehrten Formation.

2.5 **Lake City Junction (#242).** Turn right and continue east on North Bloomfield Road.

2.6 Malakoff Diggins Park sign.

3.4 Views of Malakoff Pit at the 12:00 o'clock position.

3.8 West Point Overlook. Malakoff Diggins is on the left toward the Eastern Channel Deposits. These sand, gravel and clay layers exceed 600 feet in thickness in this area.

4.1 North Bloomfield Drainage Tunnel on left. Humbug Creek on the right.

MERCURY AMALGAMATION AND THE NORTH BLOOMFIELD TUNNEL

In order to get as much gold as possible from the sluicing operations, mercury was added to the ore slurries. Several hundred pounds of mercury were recovered from the North Bloomfield tunnel after hydraulic mining ceased. Mercury can be found in the gravels of the South Yuba and other Mother Lode streams to this day. The Malakoff Diggins State Park is seeking ways to measure and remove mercury from the Yuba River.

Figure 55. Sign for North Bloofield drainage tunnel.

4.5 Diggins overlook on left (north). Placer tailings on left. Dilapidated buildings on right.

MALAKOFF DIGGINS (#245)

(Sections 1, 2, 6, and 36)

The Malakoff pit west of North Bloomfield resembles a miniature Bryce Canyon. The soft clay and gravel walls have been fluted and otherwise sculptured by erosion into "badlands" of great charm. The pastel-colored horizons in the pit gravels contract strikingly with the deep red soil mantle and the dark-green backdrop of forest trees. Some ideas of the achievement of the nineteenth-century hydraulic miners in moving such great quantities of material without modern equipment may be had from the following figures: 20,000,000 cubic yards were excavated at North Bloomfield; and 25,000,000 cubic yards from North Columbia. Only 14 percent of the gravel reserves at North Columbia had been removed by the time hydraulic mining was stopped by court injunction in 1884. The problem of the debris from such operations was, of course, a great one. It choked the rivers below and ruined riverbottom lands for farming purposes. In some places the problem has been solved by building debris dams; in others by selective spreading of waste on already valueless areas. A few hydraulic mines such as Relief and Omega situated southeast of North Bloomfield were active in 1948, but most have been idle since the 1880's (Bowen and Crippen, 1949).

Figure 56. Monitor water canon, North Bloomfield, 2002.


Figure 57. Malikoff Diggins, 2002.


Figure 58. Malikoff Diggins, monitor in hydraulic pit, 2002.

Photo 10. Malakoff pit in the North Bloomfield District was one of the largest hydraulic mines in the state. This area is now part of Malakoff Diggins State Historic Park. *Photo by Chris Higgins.* 120°45'

Figure 59. Malakoff Diggins, CGS, California Geology 50:5:156

BLUE AND YELLOW GRAVELS

The hydraulic miners worked "Yellow" and "Blue" gravels. The Blue Gravels are laid down upon metamorphic and the Yellow Gravels are deposited upon the Blue Gravels. The bedrock upon which the Blue Gravel was deposited have blue and green rocks in them. The presence of clasts and fragments of these blue-green bedrocks imparts these colors to the Blue Gravel. Due to slumping, the growth of vegitation, and filling of the Diggins with water, exposures of the Blue Gravels, the primary target for the early miners, are rare.


Figure 60. Undercutt riffles, Malakoff Diggins. (CGS Photo A4442).


Figure 61. Malakoff Diggins. (CGS Bull 141, Plate 1, 1949).

CRYSTAL HILL MINE (#243)

4.7 The Crystal Hill Mine (#243) is on the right. This is administered by the Bureau of Land Management and is under claim. You must obtain permission from the mine owner to examine the old hydraulic workings in this area. The Crystal Hill is used by the Bureau of Land Management as a training area for its geologists and mining engineers. This mine worked both Blue and Yellow gravels. Almost all of the richer Blue Gravels have been removed or are impossible to see at Malakoff State Park. Still present at the Crystal Hill Mine are the remnants of early drift mines that worked the Blue Gravels by Cornish Miners in the the 1850's. The drifts were made in attempt to get to the high-grade paleoplacers on top of bedrock without having to strip away several tens of feet of relatively gold-poor white gravels.

Cemented gravels at the Crystal Hill assay up to 1.5 ounces per ton. The Crystal Hill mine was being mined when Malakoff State Park was established in 1966, and so did not become part of the Park. The Blue Gravels at the Crystal Hill Mine were cemented by iron oxides (ferrocrete), and were not attractive to the early miners. In the 1930's to 1970's, there ferrocrete was blasted and drag lines used to process gravels above the ferrocrete layer.

Figure 62. Blue gravels on bedrock at Crystal Hill Mine, 2008.

Figure 63. Drift excavated under blue gravels by Cornish miners in 1850's at Crystal Hill Mine, 2008.

Figure 64. Drag line at Crystal Hill Mine, 2008.

4.8 Cemented gravels on the left (north). Sometimes these gravels are cemented by iron oxides, in which case they are called "Ferrocrete". The hardness of these layers make them difficult to mine, even though locally they may contain considerable quantities of gold.

5.0 School house on left.

5.4 Entering North Bloomfield historic townsite (#244).

NORTH BLOOMFIELD (#244)
(NW Section 6)

The immensity of the North Bloomfield pits must be seen to be believed. Although excavated entirely by powerful jets of water, the pits compare favorably in size with many of the open pit copper and iron mines of other states which have been excavated by modern mechanical means (Bowen and Crippen, 1949). The town is built atop the southern projection of the Ramshorn Fault Zone which justaposes Calaveras Complex rocks to the east against Central Belt metasedimeents to the west. The fault is buried beneath Mehrten andesitic pyroclastic rocks.

Malakoff Diggings-North Bloomfield visitor center has a museum, and interpretive lectures are available.

Figure 65. North Bloomfield Hydraulic Pit. CGS Photo A7195, 1890.

Figure 66. North Bloomfield Pit, 1949, CDMG Bull 141, p.79.

5.5/0.0 Malakoff Diggins at Relief Road and North Bloomfield Road.

PALEOENVIRONMENTAL STUDIES

The study of fossils and depositional environments in the Eocene gravels of Malakoff and other Tertiary channels indicates that they formed in a very tropical environment, similar to the Amazon River today. It was a hot, moist climate that encouraged deep chemical weathering. It was this climatic condition that caused the release of disseminated gold into the fluvial system and later concentration in placer deposits.


Figure 67. Plant fossil, Ancestral Yuba River.

Photo from http://www.ucmp.berkeley.edu/images/science/erwin_0609/37pb_trip600.jpg, downloaded Aug. 16, 2008.

0.0 Head out of Malakoff on North Bloomfield Road going east.

0.2 Bair Pond, site of a freakish 1992 drowning.

0.4 Eastern limit of the North Bloomfield townsite.

0.7 Shoot Hill campground to the left.

1.4 Intersection of Derbec Road and North Bloomfield Road. Turn left and go north toward North Columbia. Rocks in this area are Miocene-Pliocene pyroclastic deposits.

1.5 Malakoff School on right (east).

1.6 Derbec Meadows on left (west).

2.1 Intersection of Blackbone Road and **Derbec Road (#246).** Turn left and go west on Blackbone Road. Blackbone Road becomes the Graniteville Road, which is paved. This area is underlain by Miocene-Pliocene andesitic pyroclastics.

3.1 Intersection of Cruzon Grade Road and Blackbone Road, Blackbone Road turns southwest toward Lake City. Turn northest and take Cruzon Road to the Tyler Foote Road.

6.1 Miocene-Pliocene pyroclastic rocks (mudflows of Valley Springs Formation) in roadcuts. **Columbia Hill (#247)** is to the north.

6.3 Tyler Foote Road and Cruzon Road. This intersection is near the contact between Tertiary gravel or Valley Springs Formation and metasedimentary rocks of the Fiddle Creek Terrain of the Central Belt.

6.9 Red soils in weathered Mesozoic-Paleozoic metasedimentary rocks of the Central Belt.

7.4 Tyler Foote and Lake City Roads.

7.9 **North Columbia Schoolhouse (#248)** on right (north) atop Tertiary gravel. The San Juan Ridge Placer diggings are to the south.

8.1 Jackass Flats Road. Turn left to view San Juan Ridge Tertiary gravel deposits and hydraulic mining.

SAN JUAN RIDGE TERTIARY GRAVELS (#249)

(Sections 4, 5, 8, and 9)

8.8 Center of San Juan Ridge Eocene gravel deposits (#249).

These deposits show the effects of hydraulic mining on the environment in a spectacular way. The deposits are also among the few deposits that have not been thoroughly developed. Drill testing of this deposit has revealed large volumes of minable gravel, even using expensive underground mining methods. Look at the tree line to the north, then look at the same tree line to the south. The original surface of the land once connected those to tree lines. Where we are standing was once 250 feet below the surface. All that material was removed by hydraulic mining.

In 1992 the mine was operated by Siskon Gold Company, this underground mining project was projected to produce 20,000 ounces per year for the next seven years. The mine was closed when it unexpectedly collapsed in 1994.

The present owners have conducted an extensive revegitation testing program to see what can be done to accelerate reforestation and revegetation of San Juan Ridge. This is private property and permission from the mine operator is needed before you venture onto the mine site.


Figure 68. San Juan Ridge "yellow gravels", 2008.


Figure 69. San Juan Diggins, 2008.

GEOLOGY MAP 39

San Juan Ridge to Shaddy Creek Bridge

(Saucedo and Wagner, 1992; Yeend, 1974; Hacker, 1984)

(Bobbitt, 1982; Hacker, 1984)

Return to Tyler Foote Road.

0.0 Jackass Flats and Tyler Foote roads. Go west toward North San Juan and Nevada City.

0.4 Roadway crosses the northern rim of the Ancestral Yuba River Tertiary Channel. There are extensive hydraulic workings in this area.

1.0 to 1.2 Blue Canyon Formation in roadcuts. These are metasedimentary rocks of Paleozoic age.

1.9 to 2.1 Ancestral Yuba River Channel crosses the roadway to the northwest and strikes toward the Badger Hill area.

CHEROKEE (#250)

2.7 Historical site of Cherokee.

Hydraulic mining at the Cherokee Diggins (#250), and debris from the other diggins upstream at one time buried this area under cubic miles of tailings. Today the Shady Creek drainage is still choked with this old diggins materials.

At Cherokee, Tertiary gravel rests on Jurassic diorite and metasedimentary rocks of the Central Belt. About 0.5 miles west of Cherokee, Tyler Foote Road crosses from Jurassic diorite to Jurassic granite of the Yuba Rivers Pluton.

Between Cherokee (#250) and Mother Trucker's (#252), we cross the contact between granitic rocks of the Yuba Pluton to the west and metamorphic rocks of the Fiddle Creek Terrain of the Central Belt to the east.

3.0 Ananda Retreat Center turnoff to the right.

3.4 View of hydraulic tailings on Shady Creek drainage to the left at the 10:00 o'clock position.

SHADY CREEK BRIDGE (#251)

In the vicinity of Shady Creek bridge (#251) extensive deposits of Quaternary gravels choke the river bed. These are partly the result of placer operations connected with Tertiary gravels situated upstream (Bowen and Crippen, 1949).

3.7 Granodiorite contact.

4.3 Intersection of Purdon Road, Oak Tree Road and Tyler Foote Road. This place is called **"Mother Truckers"(#252)** .The area is underlain by Yuba Rivers Pluton.

5.4 Eroded and decomposed granodiorite terrain from this point to Highway 49.

7.7/0.0 Highway 49 and Tyler Foote Road.

Turn left and go north to North San Juan. This intersection is underlain by granodiorite of the Yuba Rivers Pluton. One mile futher west, at Pine Grove Reservoir (Section 19), is the Grass Valley Fault which justaposes Jurassic granite to the east and gabbro of the Lake Combie Complex to the west. Reset odometer. Between this point and North San Juan (#253), the roadway passes the **Sebstopol Diggins (#252)**.

RETURN TO GEOLOGY MAP 36

(Sacucedo and Wagner, 1992; Tuminas, 1983; Yeend, 1974)
(Bobbitt, 1982; Hacker, 1984)

RESUME ROAD LOG ALONG HIGHWAY 49

NEVADA CITY TO NORTH SAN JUAN

0.0 Intersection of Highways 49 and 20, north of Nevada City.

0.3 California Division of Forestry Fire Station.

0.7 Government Center on right in granite.

Indian Flat (#360)

1.2 Indian Flat Road leads to the southwest, crossing ultramafic rocks and gabbro of the Lake Combie Complex. Near this intersection is a NW-SE trending fault that justaposes diabase of the Lake Combie Complex to the east against ultramafic rocks and gabbro of the Lake Combie Complex to the west.

GEOLOGY MAP 40

Indian Flat to Sweetland

(Saucedo and Wagner, 1992; Yeend, 1974)
(Bobbitt, 1982; Hacker, 1984)

2.4 Road to Newtown and Empress Mine on the left (south).

2.9 Highway 49 follows Rush Creek in Lake Combie metavolcanics.

3.2 Lake Combie Complex gabbro at headwaters of Rush Creek.

5.0 Hilliard Ranch in basic intrusive rocks.

6.1 Independence trail. This is a mining-era water diversion ditch which has been converted into a trail that can accomodate wheelchairs.

6.9 Jones Bar is below the bridge on the South Fork of the Yuba River. Bunker Hill is to the right (east). About 0.25 miles down river, a NW-SE trending tributary in Section 33 marks the position of the Grass Valley Fault which places Lake Combie gabbro to the west against Jurassic granite.

YUBA RIVER BRIDGE ON HIGHWAY 49 (#255)

7.4 Yuba River Bridge (#255)

Close to the south abutment of the South Fork Yuba River Bridge, a broad roadcut and quarry in granodiorite afford an excellent close-up view of the intruding batholith. The coarse matrix is full of large inclusions or enclaves and several prominent joint systems prevail which have aided in quarrying the rock for fill. The river water is often discolored by tailings from hydraulic workings upstream.

The road cuts up the grade along the north wall of the Yuba River canyon expose granitic rocks of at least two separate intrusive bodies. Contacts between the intrusions are indistinct, granodiorite grading into darker hornblende diorite which is cut by light-colored dikes of variable texture (Bowen and Crippen, 1949).

9.0 Road on left goes down to Jones Bar (#256).

10.0 Shady Creek crossing (#257).

10.1 Roadcuts in granite of Yuba Rivers Pluton.

10.3 Old Highway 49 is on the right (east).

10.6/0.0 Highway 49 and Tyler Foote Road. POINT OF JUNCTURE FROM SIDE TRIP TO MALAKOFF DIGGINS. Reset Odometer.

PETERSON'S CORNER (#258)

1.0 Peterson’s Corner and road to French Corral (SW Section 17)

Peterson's Corner, 1.0 to 1.2 miles northwest of the Tyler Foote Road-Highway 49 intersection is the terminus of a road connecting with the hydraulic mining towns of Sweetland, Birchville (#260), French Corral (#259), and Bridgeport. An interesting and a scenic side trip on this road will bring one out on Highway 20 at Bitney Corner a few miles west of Nevada City. The route lies principally through granitic basement rocks of the Yuba Rivers Pluton which have been deeply weathered into a lateritic red clay in many places. An occasional belt of black or green metavolcanics of the Lake Combie Complex may be seen bordered on either side by granitic rocks. The many Tertiary gravel deposits lying on this surface are the basis for the once thriving hydraulic mines (Bowen and Crippen, 1949, modified by CGS, 1999).

SWEETLAND (#258)

(SE Section 17)

Sweetland, near present day Peterson’s Corner, was originally a placer mining camp first settled in the early 1850's. Together with adjoining towns to the southwest, Sweetland was a growing and prosperous town during the gold rush era. Sweetland is now a handful of frame dwellings set in a quiet country landscape. Birchville, 1.5 miles southwest of Sweetland, is located principally by the hydraulic pits to the north of the old town site. Several are filled with water and form small lakes (Bowen and Crippen, 1949).

GEOLOGY MAP 41

Indian Flat to Sweetland

(Saucedo and Wagner, 1992; Yeend, 1974)

(Bobbitt, 1982; Hacker, 1984)

Figure 70. Brick Store, French Corral. CDMG Bull 141. p.160.

Figure 71. Milton Mining and Water Company, French Corral. CDMG Bull.141, p. 159.

Three miles below Birchville is French Corral which dates from 1849. The town is located in an attractive valley on a tributary to the South Fork of the Yuba River. Several well preserved stone and brick buildings remain along the main street. French Corral (#259) was at one end of the first long distance telephone line ever built. It connected with Birchville, Sweetland, North San Juan, Cherokee, North Columbia, North Bloomfield and Bowman (or French Lake), a distance of 58 miles (Bowen and Crippen, 1949

BRIDGEPORT AND BITNEY CORNER (#261)

Very little remains at the Yuba River site of Bridgeport (#261), three miles southwest of French Corral. A covered wooden bridge spans the river and an overgrown graveyard is located beside the road a short distance south of the river. There is little of particular geologic or historical interest between Bridgeport and Bitney Corner on Highway 20, but the landscape is an attractive one and the side route will draw travelers who like to keep off the beaten track (Bowen and Crippen, 1949).

GEOLOGY MAP 42

Sweetland to Celestial Valley

(Saucedo and Wagner, 1992; Bobbitt, 1982; Eddy, 1985)
(Hacker, 1984; Yeend, 1974; Edelman, 1986)

North along Highway 49 from Peterson's Corner, remnants of the exhumed Eocene surface are evident in several places. This flat surface is particularly noticeable in the vicinity of North San Juan. Large hydraulic diggings can be seen to the west. The granitic basement rocks are a dark or melanistic phase of the ordinarily light-colored granodiorite, being rich in biotite mica (Bowen and Crippen, 1949).

1.9. Hydraulic workings on the left. These are the San Juan segment of the Ancestral Yuba River.

3.0 North San Juan town limits.

NORTH SAN JUAN (#254)

(Section 5)

3.3 North San Juan

North San Juan (#254) is one of the largest and best preserved of the northern gold towns. The iron grillwork on the old brick buildings resembles the grilled balconies of Old French quarter of New Orleans. North San Juan was founded about 1853 not by Spanish Californians, as the name suggests, but by Christian Kientz, an immigrant of German ancestry. He thought the hill resembled another known as San Juan and named the new spot accordingly (Bowen and Crippen, 1949). At North San Juan, Tertiary gravel rests on Jurassic granite of the Yuba Rivers Pluton north and west of the townsite.

Figure 72. Arched doorways, North San Juan. CDMG Bull. 141, p. 162.

Figure 73. Side wall of office building, North San Juan. (CDMG Bull. 141, p. 161).

Figure 74. Wells Fargo building and Masonic Hall, North San Juan. CDMG Bull. 141, p.160.

Figure 75. North San Juan storefront, 2008.

NORTH SAN JUAN TO DOWNIEVILLE

The topography along Highway 49 north of North San Juan becomes increasingly rugged and more and more typical of the higher Sierra. The northward trend to the highway changes north of

Camptonville and the route follows the bottom of the tremendous canyon of the North Fork of the Yuba in a broad northeasterly arc. Remnants of the Eocene surface become more and more restricted in aerial extent and are commonly perched well over a thousand feet above present main stream gradients. Central Belt metasediments and thick sections of Lake Combie Complex greenstones reappear south of Camptonville and granitic rocks of the Yubar Rivers Pluton outcrop in only one area between Camptonville and Downieville. Except for logged-off areas of limited extent in the vicinity of North San Juan and Camptonville, the entire region is heavily forested with coniferous trees. The fauna and flora are typical of the upper transition and lower Canadian life zones. The dominant forest trees are yellow pines and Douglas firs (Oregon pines) with lesser numbers of white firs, incense cedars, and western hemlocks. Alders and other water-loving trees grow along the water courses (Bowen and Crippen, 1949).

From the turnoff to Alleghany (Celestial Valley) to Goodyears Bar this part of the field guide does not follow Highway 49. Between Celestial Valley and Goodyear's Bar, Highway 49 goes through the mining towns of Camptonville, Frog Hollow, Joubert Hydraulic Diggins, Indian Valley and Bald Top Mountain. Geologic and historic descriptions for these areas are found in Appendix I and **GEOLOGY MAPs 54 to 56.**

3.5 East end of North San Juan. From this point to Celestial Valley, Highway 49 cuts through the Yuba Rivers Pluton with massive and decomposed exposures of Jurassic granite and granodiorite.

3.9 Tahoe National Forest Boundary. Area is underlain by granodiorite.

4.5 Clear Creek Bridge underlain by granodiorite of the Yuba Rivers Pluton.

MIDDLE FORK OF YUBA RIVER AT YUBA-SIERRA COUNTY LINE

6.2/0.0 Yuba River bridge.

Two and eight tenths miles north of North San Juan the highway crosses the Middle Fork of the Yuba at the Yuba County line. The granodiorite near the bridge is prominently jointed into rectangular blocks. One tenth of mile beyond the bridge, a dirt road (the older highway route) branches off to the east at an acute angle to the highway and re-crosses the Yuba over a covered wooden bridge much like the one at Bridgeport. It is covered as a protection against the winter snow pack and the tunnel-like appearance is typical of old mountain bridges in this region. The road connects with the famous mining district of Alleghany, located 24 miles northeast of the turnoff. Alleghany can also be reached via dirt road from Goodyears Bar, a few miles west of Downieville. Lode, drift, and hydraulic mines are located in the vicinity of Alleghany, many of which have fine production records (Bowen and Crippen, 1949).

0.1 Turnoff to **Covered Bridge (#262)** on Oregon Creek and day-use area. We will drive through the bridge and then return to Highway 49. This bridge was on the stage coach road to Alleghany. The old route is still there.

SIDE TRIP TO ALLEGHANY, FOREST CITY AND GOODYEAR'S BAR

GEOLOGY MAP 43

Covered Bridge to Pike
(Saucedo and Wagner, 1992; Bobbitt, 1982; Eddy, 1985)
(Hacker, 1984; Yeend, 1974; Edelman, 1986)

The drive beween Covered Bridge and Alleghany crosses several Terrains. Celestial Valley and Covered Bridge are in the Yuba Rivers Plutonic Suite. East of Pike, is a contact beween Yuba Rivers Pluton to the west and metamorphic rocks of the Fiddle Creek Terrain of the Central Belt to the east. At a point about 0.5 miles west of Blue Ravine there is a contact between Central Belt rocks to the west and Calaveras Belt (Terrain) rocks to the east. We cross 1.5 miles of Calveras rocks, and then pass into a narrow strip of Feather River Peridotite. These are ophiolitic ultrabasic rocks that represent a mid ocean spreading center, or a spreading center associated with a back-arc basin. After driving through serpentines of the Feather River Terrain for 1.5 miles, we pass into rocks of the Red Ant Schist Terrain at Alleghany. This pod of Red Ant Schist Terrain rocks is 4 miles wide (east-west) and 13 miles long (north-south). They are the host rocks for the mines of the Alleghany district. The Red Ant Schist is part of the Feather River Terrain.

0.0 Covered Bridge on Oregon Creek

1.7 Turnoff to Alleghany on Ridge Road. The intersection is underlain by Jurassic granite of the Yuba Rivers Pluton. Turn right and go east.

1.8 Road to **Celestial Valley (#263)** to the left. We stay to the right on Ridge Road which climbs the west flank of Pliocene Ridge between Celestial Valley and the Forest/ Alleghany/Bald Mountain area. The ridge is geologically misnamed. It is covered not by Pliocene, but by Miocene rock formations.

3.8 Exposure of slates in the metasediments of the Fiddle Creek Terrain of the Central Belt (formerly mapped as Calaveras Formation).

4.2 **Badger Hill hydraulic mines (#264)** and Tertiary channel on the right (south) across the Middle Fork of the Yuba River. Badger Hill contains the stratigraphically lower (and richer) "Blue Gravels" of the Ancestral Yuba River.

4.6 Gabbro dikes in roadcut on left (north).

5.4 Sierra County-Yuba County line.

5.8 Turnoff to historic townsite of **Pike (#267).** From the Pike turnoff to Plum Valley, Ridge Road is build, primarily, on metasediments of the Fiddle Creek Terrain of the Central Belt.

5.9 Granodiorite in roadcut.

GEOLOGY MAP 44

Pike to French Creek

(Saucedo and Wagner, 1992, Hacker, 1984)
(Ferguson and Gannett, 1932)

6.4 View of Middle Fork canyon of the Yuba river is to the right (south).

6.7 Metasediments of the Fiddle Creek Terrain of the Central Belt in roadcut.

7.3 Pliocene Ridge Schoolhouse. Pliocene Ridge is covered with a deep soil mantle and pluvial forest cover.

8.7 Squirrel Creek turnoff to the right. Mesozoic-Paleozoic metasedimentary rocks of the Central Belt in roadcuts.

9.4 Cross section of volcanic channels. This roadcut is a textbook example of this type of feature. The volcanic mudflow cut into and then filled metasedimentary "basement" rocks.

9.5 Secondary road to the Pike townsite and the Tippacanoe and Mount Pleasant hydraulic drift mines on the left (west).

9.6 Road to **Blue Grouse Mine (#266)** on the right (south). This mine is I the MzPz rock unit (Fiddle Creek Terrain of the Central Belt).

9.9 Plum Valley baseball diamond. This area was a historic placer and drift mining center. At the eastern edge of Map 44, the roadway (Ridge Road) crosses from metasediments of the Central Belt to overlying Miocene-Pliocene andesitic pyroclastics (mudflows) of the Mehrten Formation.

10.5 Deformed and weathered metavolcanics in roadcuts.

11.2 Tree plantation on Pliocene Ridge.

11.3 Mudflows deposited on eroded metasediments on the west (left) side of the roadway.

11.9 Merhten volcanic mudflows (lahars) in roadcut.

12.3 Road ascends through lava and volcanic mudflows (Miocene Mehrten and Valley Springs Formations). These form a cap on a portion of Pliocene Ridge.

14.2 360-degree view of the Sierras.

15.5 **Intersection of the Henness Pass Road, Forest and Alleghany roads (#267).** There is a historical marker at this junction. Stay to the left (south) and head toward Alleghany. Below the volcanic mud flows at this site, are metamorphic rocks of the Red Ant Hill Terrain.

15.9 **Wolzie Flat hydraulic mine (#268)** across the Middle Fork canyon of the Yuba River is on the right (south). This is the eastern part of the San Juan Ridge portion of the Ancestral Yuba River Channel.

15.8 to 16.4 Intervolcanic channel exposed as cross section in road cut.

17.1 **French Ravine crossing (#269).** From this point to Bench Mark 4421 in Section 3, the roadway approximates the near-horizontal contact between Palsozoic amphibolite of the Central Belt (hornsblendites, mafic schists and quartzites) and overlying Mehrten andesite pyroclastic mudflows. At the confluence of the French Ravine and Kanaka Creek (named for Hawaiian prospectors), coarse gold nuggets were found that set off the Alleghany boom about 1854 (Spencer, 1995).

GEOLOGY Map 45

Alleghany to Brush Creek Mine

(Saucedo and Wagner, 1992, Hacker, 1984)

(Ferguson and Gannett, 1932)

(Edelman, 1986; Hietanen, 1981)

(Southern Pacific Company, 1959)

17.7 Wet Ravine on the right represents the site of the earliest placer and lode mining activity in the Alleghany District.

ALLEGHANY (#270)

18.0 Town limits of Alleghany (#270).

18.1 Road forks. Turn left (north) to go on upper town road.

18.4 Hydraulic workings can be seen across canyon to the right (south).

18.6 "Downtown" Alleghany. Turn to the right at the town bell and commemorative plaque. Take this road to double back and go through lower Alleghany. The Alleghany Musuem hosts surface and underground tours of the 16 to 1 mine. Check out their website at http://www.origsix.com.

"The Whopper" is the largest specimen in our gold collection. It weighs approx. 13 lbs and contains appox. 140 troy ounces of gold. (From http://www.origsix.com, Oct. 27, 2008).

18.8 Alleghany cemetery.

18.9 Alleghany community park.

19.0 Turnoff to the 16-to-1 mine (#271). This is private property and permission must be obtained prior to going through the gate.

19.6 Outcrops of the Tightner Formation capped by white quartz gravels of the Ancestral Yuba River.

19.8 Fork in road. Stay to the right, go east toward the 16-to-1 mine.

19.9 **Sixteen to One Mill Building (#271)**. Kanaka Creek is on the right (south) as is Chips Flat. Remnants of the Tertiary Ancestral Yuba River Channel is exposed on LaFayette Ridge which forms the skyline to the south.

Figure 76. 16-to-1 Mine, Alleghany, 1941. (CGS Photo A-0282).

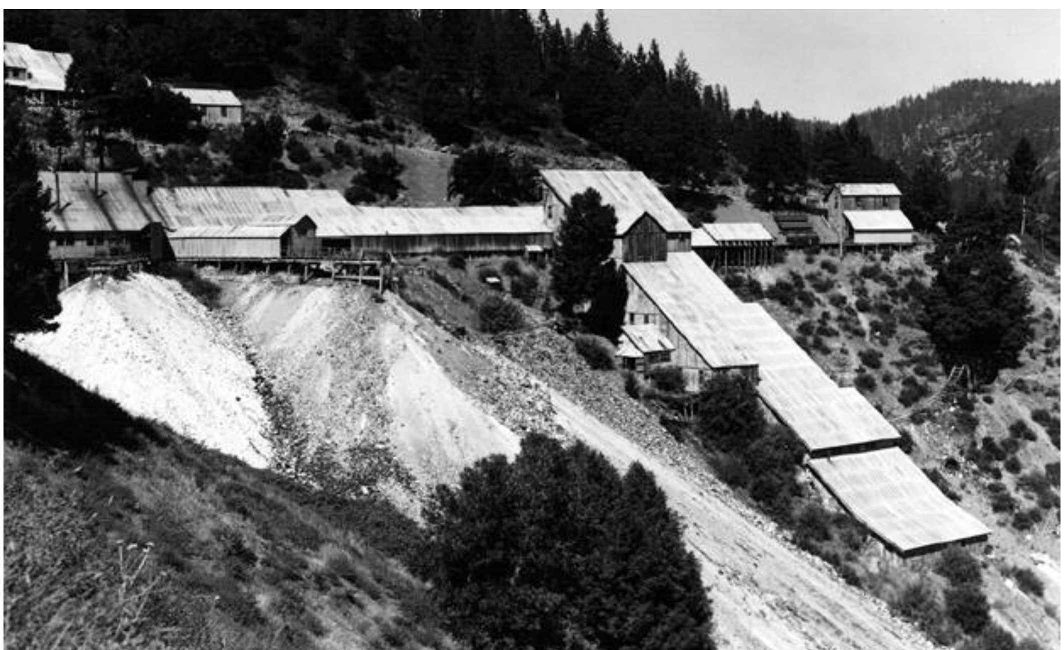


Figure 77. 16-to-1 mine and tailings, 1942. CGS Photo A-0283.


Figure 78. Trucks on Tyler Foote Road, 1923. CGS Photo A-7115.

ALLEGHANY DISTRICT: SIXTEEN-TO-ONE AND OTHER MINES

The best known lode mines in the Alleghany District are the Sixteen-to-One, Oriental, Plumbago, Rainbow, and Bush Creek, all of which have recorded productions in the millions of dollars. The Sixteen-to-One has over one million ounces ($390,000,000) of production since 1854 (Spencer, 1995). Dozens of smaller workings have been profitable from time to time. The Brush Creek and Yellow Jacket mines were operation early in 1948 as well as the major Sixteen-to-One (Bowen and Crippen, 1949). The town and district are named after the Alleghany drift mine, and named that by Pennsylvanian miners working Eocene auriferous gravels (the "Great Blue Lead" (Spencer, 1995).

Sixteen to one is the arbitrary ratio of the number of ounces of silver equal in value to one ounce of gold in the bi-metallic monetary system established by Portugal in 1688. The ratio had profound effects on the world's monetary arrangements for many years, and was adopted by the United States of America in 1792.

The sixteen to one system was dropped by the United States in 1873, enraging the silver producers. William Jennings Bryan advocated a return to the sixteen to one policy in his presidential campaign of 1896, claiming that the inflationary effect of flooding the market with silver ("free silver") would benefit the common man's ability to pay his debts. However, when William McKinley defeated him, the issue was considered dead thereafter and the gold standard remained firmly in place.

In February 1934, in response to the pressures of the depression, the government reduced the value of the dollar to 59.06% of its previous amount - increasing the price of gold from $20.67 to $35.00 per ounce. On March 17, 1968, the London Gold Pool was dissolved and the United

States went off the gold standard, meaning that gold was no longer a valid support for paper money and the price of gold would now fluctuate with supply and demand and the whims of "the politicians". In 1975, private individuals were allowed to own gold. Gold prices peaked at $850 an ounce in 1980, followed by a low of $284 an ounce in 1985. The price remained fairly consistent at $350 to $400 an ounce for the past decade. Recent prices of gold established a new low of approximately $253.00 an ounce. (http://www.origsix.com/tmarticle.asp?id=122, Oct. 27, 2008).

The Alleghany District lies in a fault block terrane known as the the Feather River Peridotite Belt. Members of this group of rocks include the Peridotite of the Melones Fault Zone and Paleozoic amphibolite. The Feather River Belt lies between the Melones Fault to the east and the Goodyears Bar Fault to the west. Within the Alleghany District can be found Blue Canyon Slate, Cape Horn Slate, Delhi Phyllite, Kanaka Conglomerate, Relief Quartzite and Tightner Schist (Spencer, 1995).

The Sixteen-to-One, located a short distance downhill toward Kanaka Creek from the town of Alleghany, has been the principal producer of the district. It was discovered in 1876 and, as now operated, is a consolidation of the Twenty-One and Tightner mines and several miscellaneous properties. The main vein system lies along a reverse fault in which are found blocks of of hornblende schist and other metamorphosed sediments of the Tightner and Kanaka members of the Calaveras formation. Serpentine dikes cut the Calaveras and both are cut by the thrust system. Vein minerals from the Sixteen-to-One include arsenopyrite, mariposite, sphalerite, gold, graphite, chalcopyrite, quartz, ankerite, tetrahedrite, galena, pyrrhotite, and pyrite. The deepest part of the mine is 3,300 feet form the surface as measured along the inclined Tightner shaft (Bowen and Crippen, 1949).

Stringers of the main Tightner Vein were known by miners working the auriferous Blue Gravels in the Alleghany and Knickerbocker drift mines. In 1891, a re-opening of the Knickerbocker Mine uncovered the vein and a winze was made along it. The vein tightened at depth, hence the name "Tightner". Exploration on the southern extension (called the Contract Extension) in 1903 was more successfull, and gold was produced from it almost immediately. In 1986, a resident of Alleghany, Tom Bradbury, commenced working his Sixteen-to-One claim in his back yard. The name was in commemoration of the silver/gold ratio for U.S. coinage promised by presidential candidate William Jennings Bryan. The Sixteen to One, Tightner, and other claims were incorporated into the "Original Sixteen to One" mine in 1911. Later working of the Tightner and Sixteen-to-One Veins showed them to be on the same vein system. Several rich orebodies were found along the vein, and from 1922 to 1935 they produced over 240,000,000 ounces of gold. During the Great Depression, it was a very profitable mine with a workforce of 85 to 100 men. The mine was not closed down, as were many gold mines between 1942 and 1945, and the mine operated with a crew of 45 after the World War II up to 1965 (Spencer, 1995).

The mine was re-opened in 1976 and has operated continuously since that time with a work force of 5 to 10 persons, depending on the time of year. The mine uses metal detectors to help find the gold-rich portions of its quartz veins. This mine is noted for the purity of its ores (all gold and quartz with no other minerals). The owners sell specimens and also refine non-specimen quality ore into bullion. Waste from the mill is disposed of in old underground workings.

Hydraulic mining in the Alleghany district was confined to a few favorable locations where the gravels were not deeply buried under the Tertiary rhyolitic lava cap. Ferguson has estimated that between 83,300 and 166,700 ounces ($2,000,000 and $4,000,000) were extracted from the district by hydraulic means. Something in excess of 400,000 ounces ($10,000,000) was produced form drift mines such as the Ruby and about 1,120,000 ounces ($28,000,000) from lode mines. Placer gravels, principally of Quaternary age added over 40,000 ounces ($1,000,000) to the above totals, giving a grand total of over 1,520,000 ounces ($38,000,000) for all gold mines in the district. Ferguson and Gannett (1932) give another interesting sidelight on the richness of the Alleghany lodes. They compiled, from various authorities, a table of the probable amounts of gold eroded from the Alleghany lodes and redeposited in channel gravels below. These estimates ranged from 72,000 ounces ($18,000,000) to 2,080,000 ounces ($52,000,000; Bowen and Crippen, 1949).

The 16-to-1 mining company is was sellings its gold specimen collection in the fall of 2008 which, at that time, had an estimated worth of $3.5 million.

RETURN TO JUNCTION OF HENNESS PASS AND FOREST ROAD

0.0 Junction of Pliocene Ridge Road, Allegheny Road and Forest Road (#267). Turn right, go north toward the town of Forest.

0.1 Pliocene Road is to the east or west. Keep going northeast on Mountain House Road toward Forest.

0.7 Mud flows are exposed for the next mile on the right (east) side of the roadway. The volcanic cover in the Forest area exceeds 1000 feet in thickness.

FOREST CITY (#273)

1.9 Oregon Creek at historic Forest City town site (#273). The Bald Mountain drift mine to the north produced over $60 million in gold.

2.0/0.0 Road intersection at Forest. This town retains many historic buildings that are still in residential use.

Figure 79. Penberthy's General Store.

From http://www.ghosttownexplorers.org/california/forestcity/forestcity03.htm, Sept. 12, 2008

Figure 80. Dance Hall, built 1883.

From http://www.ghosttownexplorers.org/california/forestcity/forestcity01.htm, Sept. 12, 2008.

Figure 81. Forest City school house, built 1874 and used through 1930.

From http://www.ghosttownexplorers.org/california/forestcity/forestcity05.htm, Sept. 12, 2008.

0.0 Cross Oregon Creek bridge and head west toward Goodyear's Bar on Mountain House Road.

1.8 E Clampus Vitus Historical Marker: Stage Line Holdup. The marker reads: “On July 1, 1887, an attempt was made to rob the Forest City Stage carrying a shipment of gold from the Bald Mountain Extension Mine. Tom Davis, driver, Ben Treloon, shotgun, were ordered to halt but were shot and wounded before the stage could be stopped. The horses broke into a run pulling the stage clear of the ambush. A posse was mounted, but the bandet escaped down the Oregon Creek gulch without the gold.”

1.9 Serpentine outcrop, rocks of the Feather River Terrain.

2.4 Forest City cemetery on right (north).

2.7. Turn north on Sandusky Road

3.1 **Sandusky Creek crossing (#274).**

3.3 Henness Pass Road to the left leads southwest to the **Kate Hardy Mine (#275).** Taking Henness Pass Road right leads northeast to the **Ruby Mine (#276).** Going north on Alpha Colony Road takes you to the **Magnolia-Kirkpatrick Mine (#277).**

RUBY DRIFT MINE (#276)

The Ruby drift mine (#276) is below the Ruby Bluff near the headwaters of a north-south trending tributary to Rock Creek, southeast from Goodyear's Bar. It is famous for its coarse gold nuggets and its large quartz crystals. It is one of but few mines in the district which has been operating in recent years. The workings are principally tunnels in the bedrock from which raises are put up to the channel gravels above. There are several miles of tunnels and drifts and several vertical access and escapeway shafts. Ore is hauled out along the main tunnel level and run through sluices. More than 123 nuggets valued at over $100.00 (4 ounces) each had been removed from the Ruby by 1941. The largest weighed 52.3 ounces and was worth $1,758.00 (Bowen and Crippen, 1949).

The Ruby Mine currentl consists of 1,750 acres with approximately 430 acres of fee title land and the remaining holding roughly 30 unpatented mining claims. A gold mining facility with placer and Quartz milling & processing plants including extensive underground tunnels, buildings and equipment. This highly desirable and extremely versatile property boasts panoramic views, year round springs, loggable timber, paved & gravel road access & electricity that runs through the center of the property. The fee land has several building sites with huge views & excellent mix of trees. The Ruby Mine is famous for its coarse slugs of gold, and produced what is reputed to be the most spectacular collection of huge gold nuggets in existence. Geologists estimate that several miles of channel remain to be mined within the Ruby Mine property holdings. Quartz veins on the Ruby have yielded specimen high-grade lode gold as well & are thought to have produced much of the placer gold recovered from the Ruby's channels. The Ruby Mine's forested & usable easily accessible land is rare. (From http://www.loopnet.com/property/14714654/Old-Henness-Pass-Rd/, Sept. 12, 2008)


Figure 82. Ruby Mine tresle from mine portal to winter storage area.

From http://www.ghosttownexplorers.org/california/ruby/02.htm, Sept. 12, 2008.


Figure 83. Gold specimens from the Ruby Mine

From http://www.loopnet.com/property/14714654/Old-Henness-Pass-Rd/, Sept. 12, 2008

Go west on Hennes Pass Road.

3.8 Tightner Formation metasediments.

4.0 Mudflow on right.

4.3 Serpentine on right. This is the same rock unit that hosts the veins at the Kate Hardy mine.

4.8 Ramshorn Fault Zone and Serpentine Belt.

6.1 Road to right is an alternate route to Forest. It is the lower Mountain House Road.

VIEW OF RAMSHORN FAULT ZONE IN WOODRUFF CREEK AND GOODYEARS CREEK

6.2 **Old Mountain House Site (#278).**

The Ramshorn Fault is a major structural suture zone extending for 10 miles north and 4 miles south of this point. It is a highly mineralized zone and contains rich lode gold deposits (e.g. Brush Creek Mine). There are also several rich placer deposits in this area: the Magnolia, Newkirk and Colony mines. The fault zone follows both Woodruff Creek and Goodyears Creek. These are south and north of the North Fork Yuba river respectively. The Yuba river cuts across the Ramshorn Fault Zone at a 90-degree angle.

Ramshorn Fault zone has created a broad valley over one mile wide. Fir Cap Peak is at the head of Goodyears Bar to the north.

6.3 Road to left at Mountain House Junction goes to Pioneer Dark graveyard. This is the Slaysville Ridge Road. Take Mountain House Road north to Goodyear's Bar

GEOLOGY Map 46

Forest City to Goodyear's Bar

(Saucedo and Wagner, 1992, Hacker, 1984)
(Edelman, 1986; Hietanen, 1981)
(Southern Pacific Company, 1959)

7.0 Road descends to Woodruff Creek.

BRUSH CREEK MINE (#279)

7.2 Gate for upper Brush Creek Mine and Mill site.

9.8 View of Grizzly Peak at 12:00.

9.9 Rock Creek is to the right. This is a tributary to Woodruff Creek and is rich in modern placer deposits that have formed from modern rivers cutting through and enriching older Ancestral Yuba River gravels.

10.3 Serpentine of the Ramshorn Fault Zone.

11.2 Junction with the lower Brush Creek Mine Road to the right.

11.4 Road parallels Woodruff Creek. There has been a small amount of historic placer production from this area.

11.7 Woodruff Creek Bridge.

11.9 Historic townsite of Goodyears Bar.

GOODYEARS BAR #280

Goodyears Bar (#280), located near the junction of Woodruff and Goodyear Creeks with the Yuba four miles west of Downieville, was settled in the summer of 1849. It prospered during the 1850's before its rich placers were exhausted, but a fire which virtually destroyed the town in 1864 culminated a steady decline which had begun some years earlier. A good dirt goad from the Alleghany mining district joins highway 49 in the vicinity of Goodyears Bar (Bowen and Crippen, 1949).

The following information about Goodyears Bar was taken from http://malakoff.com/goldcountry/goodyear.htm, Sept. 10, 2008:

The brothers Miles and Andrew Goodyear, along with a Dr. Vaughan and a Mr. Morrison, prospected here in the summer of 1849 and found gold enough for their liking to settle down at this crossing of the Yuba River. The Goodyear boys built a sturdy cabin and before long the rich deposits attracted a number of miners to their camp, which was given the name Goodyears Bar in honor of its founders.

Miles Goodyear, a native of Connecticut, had come west with a missionary party led by Dr. Marcus Whitman who was on his way to establish a mission along the Columbia River. After a falling out with the good doctor, Miles headed off into the wilderness and eventually settled down in Utah Territory, building a cabin of cottonwood logs in either 1844 or ’45 on the site of the future town of Ogden. When the Mormons arrived a couple of years later, Miles left and joined his brother in California and began prospecting. Shortly after settling down at Goodyears Bar, Miles took ill, and after lingering on for a few months, died on November 12 of 1849. Andrew wrapped his brother in a buffalo robe and buried him in an old rocker on a point opposite the bar, where he remained until his brother took his bones to Benicia, his final resting place.

Goodyears Creek was incredibly rich along its entire length, having been literally fed gold for thousands of years as it chewed through gold-bearing ledges and the beds of ancient rivers and streams. At one spot near the upper end of the bar, a group of men cleaned up $2,000 in gold from a single wheelbarrow of dirt. Finds such as this spurred the miners to prospect every bar on the river, resulting in some of the most interesting named camps in the Gold Country. Cut-Throat Bar, so named because a sick German cut his own throat there. Hoodoo Bar, named for the peculiar manner in which the local Indians said “How-dye-do.” Nigger Slide, St. Joe’s Bar, and Ranty Doodler Bar (spelled variously as ‘Rantedottler,’ ‘Rantedodler,’ ‘Rantedottler,’ and ‘Ranse Doddler’) were all rich camps in the vicinity.

The camp suffered great hardships during the winter of 1849/50 as snowfalls came earlier and in greater depths than usual. Food became terribly scarce as supply trains could no longer reach the town. When parties from the outlying camps came in with the hopes of purchasing supplies, they found what little there was to buy—food, tools, or blankets—sold for the same price: $4 a pound. Many left for lower ground to wait out the winter. Some of those who remained were forced to dine on beef bones from a dead animal found lying on the bar before supplies finally arrived.

Good fortune returned to the bar with the arrival of spring. In fact, the area grew so rapidly between the years of 1850 and 1852 that the claims staked along the Yuba, Goodyears Creek, Woodruff and Rock creeks formed an unbroken chain which rivaled Downieville in importance. Goodyears Bar had all the trappings of civilization; express office, saloons, stores, hotels, bakeries, restaurants, churches, and many cabins and dwellings. The post office was established on October 7 of 1851, with Mr. Woodruff as the first Postmaster and by 1852 the camp polled more than six hundred votes. Mining was being carried on extensively, mostly with flumes erected to divert the waters of the Yuba so the rich bed could be worked thoroughly

The town’s first school was a private one begun in 1856 with a Mrs. Massey as the first teacher. The money needed for the erection of the schoolhouse and for the teacher’s salary came from donations made by the townsfolk. If additional monies were needed for books or furnishings, a fund raiser would be held, generally raising the amount needed.

The Schoolhouse in Goodyears Bar was built by public subscription in 1862 to serve for various church and public purposes. Upon its completion, fifty-two children between the ages of four and eighteen attended classes in the one-room building. The average school term during the town’s early years was only five and a half months, due in part to the severity of the mountain winters.


Figure 84. Goodyears's Bar schoolhouse, originally built 1862.

With a good number of kids in town, it's no wonder there were also a bunch of dogs. In fact, there were apparently too many dogs at one time, for early in the town's history the following notice was posted:

NOTICE TO DOGS

"All dogs within the limits of Goodyears Bar will please take notice, that by the laws of said town, you are required to call immediately to the marshall's office and obtain a tag. On and after four days all dogs found within said limits without a tag will be impounded at their own expense, and after imprisonment for three days will be shot until they are dead." Records fail to show if the dogs heeded the notice.


Figure 85. St. Charles Hotel, originally built 1850's.

Nothing much from the mining days remains in Goodyears Bar, but the beautiful setting of this historic gold camp more than makes up for any lack of Gold Rush remains. Situated at an elevation of 2,700 feet, the town rests on a small flat on the south side of the Yuba River, almost upon the abandoned diggings themselves. Towering mountains surround the old river camp—Saddle Back, Monte Cristo, Fur Cap, Grizzly Peak, and others—cloaked with a thick green mantle of pines, oaks, maple and dogwood, except for spots where the granite rock of the Sierra remains uncovered.

12.0 Stop sign. Turn left.

GOODYEAR'S BAR TO YUBA PASS

GEOLOGY MAP 49

Goodyear's Bar to Montrose Mine

(Saucedo and Wagner, 1992; Hietannen, 1976, 1981)
(Edelman, 1986; Bobbitt, 1982; Eddy, 1985; Yeend, 1974)
(Southern Pacific Company, 1959; Hacker, 1984; Berquist, 1986)

12.1 Cross North Fork of the Yuba River. Terrace gravels can be seen at the west end of the bridge.

12.2/0.0 Junction of Highway 49 and Mountain House Road. Turn right on Highway 49 and go east toward Downieville. Serpentine is exposed in the road cut east of this intersection.

SERPENTINE OF THE FEATHER RIVER PERIDOTITE BELT

There is a geometric relationship between gold deposits and serpentine belts. The California Mother Lode and South African gold deposits are classic examples. The processes that create serpentine are associated with those that concentrate gold in orogenic\continental accretion processes. Serpentine is a mineral. Serpentinite is the scientific word for a rock made up of serpentine. However, the California legislature took it upon themselves to make Serpentine the State Rock, prompting this soliloquy:

A scholar I resent a mite
Calls SER-pentine ser-PENT-inite
I know full well this self-same gent
Might call a SER-pent a ser-PENT

If the English language you would not demean
Please call this green rock SER-pentine

0.1 Cross section of Ramshorn Fault Zone metasediments.

Three-tenths of a mile east of Goodyears Bar is a prominent outcropping of serpentine which is associated with fine-grained dark intrusive rocks. Half a mile east of the serpentine belt is a small area of meta-gabbro. The fine-grained basic rocks are cut by quartz veins (Bowen and Crippen, 1949). These rocks are part of the narrow band of ultramafis that are classified as part of the Feather River Terrain. On the east side of the Ramshorn Fault is Red Ant Schist Terrain

A broad zone of faulting and deformation is visible along the highway 1.4 miles west of Downieville. The meta-volcanics there are much contorted and, in many places, are impregnated with pyrite. In the stream bed below, deep circular depressions known as potholes or kettles spinning action of rapid water over uneven, bare rock. Gravel and pebbles caught in the depressions are spun by the currents and aid in the circular downcutting effect. They are a common feature along streams of considerable gradient (Bowen and Crippen, 1949).

0.2 Serpentine.

0.4 Gravels lie atop metamorphic rocks of the Calaveras Complex (Saucedo and Wagner, 1992) or Red Ant Schist (Irwin and Wooden, 2001).

0.8 Metavolcanics of the "Yuba Terrain" are part of the Calaveras Group of rocks outcrop for the next 3 miles.

2.3 Rosassco Ravine to the left (north). City of Six Ridge is to the southeast.

2.4 Old Toll House Road crossing is on the right (south).

3.0 Coyoteville historic site. This is now a resort.

3.4 Slug Canyon on right (south).

3.6 Turnout to right at Canon Point. Overview of Downieville.

DOWNIEVILLE (#288)

3.8/0.0 Downieville town limits

Downieville (#288), county seat of Sierra County, is situated at the junction of the north and east branches of the North Fork of the Yuba River. Lofty tree-covered mountains surround it on all sides and it is a fitting location for the center of a well named county. There is very little flat land in the county and this is located either along river bottoms or on upland remnants of the Eocene surface. Like Goodyears Bar, Downieville was found in 1849 by a party of gold seekers. Originally known as The Forks, the name was changed to Downieville in honor of William Downie, one of the initial settlers. More than 5000 people jammed the town in 1851 and some rich strikes were made. So determined were the miners to get the gold from the bed of the Yuba that they flumed and diverted the river from its bed between Downieville and Goodyears Bar. This worked beautifully as long as summer held out, but winter floods quickly wiped out the project. After the placer mines were exhausted, gold mining went on in hydraulic, drift and a few lode mines. Very few historical buildings remain, the County Courthouse and St. Charles Hotel having burned in 1947. The Pioneer Museum, a well-built stone building with iron doors and window shutters, was restored by the heirs of pioneer J.M.B. Meroux and dedicated to the Pioneers of Sierra County by the Native Sons and Daughters of the Golden West in 1932. Costa's grocery store, also of stone, dates from 1852 (Bowen and Crippen, 1949).

Figure 86. Building behind the Ponta Hotel, Downieville, 1949. (CDMG Bull 141, p. 163).


Figure 87. Downieville Museum Building, 1949. (CDMG Bull. 141, p. 162).


Figure 88. Placer workings east of Downieville, 1949. (CDMG Bull 149 p. 18).

Figure 89. Crayford Building, Downieville, 2008. Originally built in 1852.

From http://www.ghosttownexplorers.org/california/downieville/downieville.htm#bmark, Sept. 16, 2008

Figure 90. Mountain Messenger, Downieville, 2008. Originally built in 1852.

From: http://www.ghosttownexplorers.org/california/downieville/downieville04.htm, Sept. 15, 2008.

0.0 Downtown Downieville, underlain by Calaveras Complex (Terrain) and Mesozoic-Paleozoic metasediments. The Melones Fault Zone crosses Highway 49 0.5 miles east of

Downieville. This fault separates undifferentiated Mesozoic and Paleozoic rocks to the west from Shoe Fly Complex sandstones, siltstones and slates to the east.

DOWNIEVILLE TO SATTLEY

The northeastern end of Highway 49 lies along the headwaters of the North Fork of the Yuba and then climbs out of the Yuba drainage system and over Yuba Pass to the broad upland of Sierra Valley. Yuba Pass does not show the tremendous alpine landscape that is so typical of the passes to the south such as Tioga and Sonora. The greatest relief to be seen on Highway 49 is along the route form Camptonville to Sierra City. However, the end of the route is through heavily forested country full of streams, and the beauty of the woodlands partly compensates for the comparative lack of alpine features (Bowen and Crippen, 1949). Between Downieville and the Kentucky Mine, east of Sierra City, Highway 49 traverses rocks of the Shoo Fly Terrain.

0.2/0.0 Bridge over North Fork of the Yuba River. The confluence with the Downie River is 150 yards downstream. Reset odometer at this bridge.

0.1 Black Slates of the Shoo Fly Complex.

Immediately east of Downieville the roadcuts are in a belt of black slates which have been quarried for local use as a building stone. The slates are full of quartz veinlets which have invaded the series along the bedding planes. These slates closely resemble the Salt Springs (Black) Slate Member of the Mariposa Formation of the southern Mother Lode. They were assigned to the Calaveras formation by H. W. Turner (1987). These rocks are now recognized as part of the Shoe Fly Complex. Quartz veins varying in width from fractions of an inch to two feet cut the country rock in many places along the road from Downieville to Sierra City. Although barren for the most part, some of these veins have been found to carry pocket gold. Several prospect holes close to quartz veins can be seen on the south side of the river. Granodiorite outcrops in several places in this vicinity and the quartz veins were undoubtedly derived from adjacent or underlying granitic intrusion (Bowen and Crippen, 1949, modified by CGS, 1999).

0.7 Hungry Month Canyon to right (south).

0.8 Placer workings on right (south), between highway and river.

1.0 Resort on the right (south).

1.2 Vertical beds of slate on right (south).

2.6 North Fork Terrain rocks of the Show Fly Group. Placer workings to the right (south).

2.8 Sierra Shangrala Resort and confluence of Jim Crow Canyon and San Juan Canyon. The **Arizona Mine (#363)** is above the headwaters of San Juan Canyon atop the ridge.

This mine is not on Map 49. It is shown on Regional Map 09. The slate formations at the Sierra Shangrala Resort are oriented perpendicular to the current flow direction of the Yuba River. These made a natural riffle affect, and so this site was a place where placers were particularly rich.

GEOLOGY MAP 50

Montrose Mine to Loganville

(Saucedo and Wagner, 1992; Schweickert and Hanson, 1984)

POCKET MINES

This region has many "pocket mines". These are small concentrations of rich paleoplacers, often having only a few hundred tons of material in them. Careful study of the rocks, veins, soils and sediments around the pockets sometimes leads to short-lived discoveries.

3.0 Jim Crow Canyon on right (south).

3.8 North Yuba modern placers were heavily worked historically between this point and Sierra City. Placer workings on stream benches are seen along both sides of the Yuba River.

4.9 Metal footbridge over Yuba River.

YUBA CAMP (#289)

5.1 CAMP YUBA (now Union Flat Campground, #289) in Show Fly complex rocks. Union Flat is the site of a north-south striking thrust fault with the upper plate to the east. The fault places tonalite of the Bowman Lake batholith against Paleozoic Shoe Fly sandstones. The Bowman Lake batholiths is Late Devonian (370 m.y.) or older (Irwin and Wooden, 2002).

Camp Yuba, 5.4 miles east of Downieville, is another of the very fine public camps situated on the banks of the river. This camp is near the old placer camp site of China Flat. Several lode gold mines are located both to the northeast and southeast of Camp Yuba and the Ladies Canyon bridge include a small body of weathered granodiorite which looks as if pre-existing wall rocks had been assimilated by it. It is a dark, impure rock resembling a granite in texture only. Excellent examples of hill creep or false folding in platy meta-sediments may be seen along the roadside in several places. Hill creep is produced on steep slopes by gravitational bending of inclined strata in a downhill direction and is usually the result of downhill movement of the soil mantle which lies above the titled edges of the stratified bedrock (Bowen and Crippen, 1949).

7.0 Road to Gold Point Road is on the left (north).

7.2 **Ladies Canyon Creek (#290)** with rich placers upstream.

Between Ladies Canyon and Sierra City a wide variety of interbedded meta-sediments, meta-volcanics and dike-like intrusives are exposed in the many roadcuts. Slate, phyllite, schist, chert, quartz porphyry, serpentine, and green meta-volcanics can all be collected at various places along the highway. Terrace alluvium perched high above the present stream channel may be seen in the vicinity of Fournier Ranch and Loganville (Bowen and Crippen, 1949).

7.6 Negro Canyon on right (south). The Cleveland mine is on the east side of Negro Canyon.

8.0 Small turnout with placer workings to the right (south) on the south side of the North Fork of the Yuba River.

8.4 **Fournier Ranch (#291).** Over the past few years, placer operations at Fournier Ranch have produced up to 100 ounces of gold a week for several seasons. Al Dupree was the operator.

8.6 Charcoal Ravine on the right.

9.5 Keystone Mountain on right (south).

10.1 View of **Keystone Mine (#292)** on the right (south). The lower portion of the canyon is not visible from this point and is the location of the Lucky Boy Mine.

LOGANVILLE

10.2 Loganville (**Shanon's Cabins, #293**). Northwest of Loganville are the Primrose, Buffalo, Monarch, Sovereign, and Columbo mines.

GEOLOGY MAP 51

Loganville to Bassetts

(Saucedo and Wagner, 1992; Schweickert and Hanson, 1984)

10.9 Forest Service Loganville campground.

11.0 Big Avalanche Ravine to the right (south).

11.3 4,000 ft elevation sign.

11.8 Metavolcanics and metasediments are exposed in roadcut.

12.0 West end of Sierra City

SIERRA BUTTES (#364)

12.5 Sierra Buttes and Sierra Buttes Mine (#364) to the left (north). These are composed of rhyolitic to andesitic flows, breccias, tuffs and cherts of the Devonian Sierra Buttes Formation

At this point another thrust fault crosses the roadway, about a mile west of Sierra City.

SIERRA CITY (#294)

12.9 At the edge of Sierra City, a road leads off to the north which connects with Sierra Buttes mining district. As mentioned in preceding paragraphs, the Sierra Buttes district is noted for the many large nuggets recovered there in early days. There is little or no activity in the district at present. The columnarly jointed lava cap of Sierra Buttes can be seen in many places along the highway in the vicinity of Sierra City (Bowen and Crippen, 1949).

Sierra City (#294), located at the foot of towering peaks on a narrow river terrace, was first settled in 850 by gold miners. The vicinity was full of Indian rancherias or camp sites and apparently was one of the most heavily populated Indian districts in California. The new settlement was destroyed by an avalanche in 1852 and the present buildings date from the 1860's or later. The main street of Sierra City resembles those of many other towns of the gold country. The brick-and-frame Busch Building has the same iron doors and shutters that are so typical of fire-conscious towns built in the 60's and 70's. Sierra City is famous for being the birthplace of a roisterous society known as E. Clampus Vitus. The organization has the reputation of being principally a perpetrator of practical jokes upon the uninitiated. At any rate, name and reputation are colorfully connected with the history of Sierran gold mining from Sierra City far down the Mother Lode. The society was reorganized several years ago by the California Historical Society, apparently with satisfactory results to all concerned (Bowen and Crippen, 1949).

13.4/0.0 East end of Sierra City at road milage sign.

Remnants of glacial moraines lie between the highway and the river in this area. Here, also is a sliver of metavolcanic rocks 0.5 miles west of town. On the east end of town is a contact with quartz porphyry volcanic rocks of the Sierra Buttes Formation. East of Sierra City are thin (0.5 mile wide) slivers of marine conglomerate, sandstone and chert of the Devonian Grizzly Formation.

0.1 Wild Plum Road to right (south).

0.4 View of Haypress Canyon.

KENTUCKY MINE AND MUSEUM (#295)

0.5/0.0 Turnoff to Kentucky Mine Museum on left.

This restored mine and mill are well worth the $4.00 entrance fee. Reset odometer. The mine entrance and mill rest on metavolcanic rocks of the Shoe Fly complex.

This museum contains displays and artifacts about Native Americans, early-day mining, logging, pioneer skiing, and day-to-day life a hundred years ago. Outdoors, mining relics and picnic tables dot the shady landscape.But the heart of the park is the lovingly preserved Kentucky Mine. The Pelton wheel and stamp mill just outside the mine's entrance present a vivid picture of what life must have been like for the hard-rock miners of a hundred years go. Docents lead tours of the stamp mill, explaining how the ore was ground into fine particles to extract gold and recalling anecdotes from the day-to-day lives of the miners. Working conditions here a century ago were not ideal. Mercury poisoning commonly affected the workers. Noise in the mills was extreme. After six months the workers would be completely deaf.The mine has operated off and on since the early 1850s. A five-stamp mill completed in 1863 was increased to ten stamps in 1888. The mine was abandoned for some time, then Emil Loeffler of Sierra City relocated the mine in 1910, operating it with his son, Adolph, "Dutch" Loeffler.The existing six-level stamp mill, build beginning in 1928, is built to standard specifications primarily from materials salvaged from nearby abandoned stamp mills. The mine operated until 1953.In 1974 Sierra County purchased the Kentucky Mine and by 1977 completed and dedicated the small museum on the site. The Sierra County Historical Society now operates the museum, which is self-supporting through admission fees. Pay $1 per person for the museum, or $5 for a tour of the stamp mill and 80 feet of the adit (mine tunnel) and museum, scheduled at 11 a.m. and 2 p.m. on each day the mine is open. (From http://www.sierrafoothillmagazine.com/kentucky.html, Sept. 15, 2008).

0.0 Kentucky Mine Turnoff. Go east toward Sattley. East of the Kentucky Mine, Highway 49 crosses tuff, red slate, quartzite, limestone and conglomerate of the Milton Formation. At the Kentucky mine is a contact between Shoe Fly Complex (Terrain) rocks to the west and Taylorsville Sequence rocks to the east (Irwin and Wooden, 2001).

GLACIAL DEBRIS

0.8 Glacial debris resting on andesite breccia, tuff and slate of the Carboniferous Taylor Formation.

East of Sierra City, Highway 49 passes close beside an east-west contact between the quartz-porphyry bedrock and overlying glacial moraine detritus. This is the first appearance of glacial debris along Highway 49 but morainal deposits can be seen in a great many places between Sierra City and Bassett at the foot of Yuba Pass. The most obvious characteristic of the glacial deposits is their extreme variability or heterogeneity. Clays, gravel, and huge boulders both stratified and unstratified are dumped together in irregularly shaped deposits. Some of the fragments or clasts have been planed off or faceted by the ice. Others have been grooved or striated by being ground against resistant bedrock. Most of the boulders and smaller stones are merely rounded or subangular and one must examine many of them to find any which have characteristic glacial markings. The quartz porphyry east of Sierra City is a light-buff rock with a very fine-grained groundmass and numerous small, rounded, quartz crystals or phenocrysts and less numerous rectangular or lath-shaped feldspar phenocrysts. The rock is probably close to a dacite in over-all composition. East of the quartz porphyry belt of green porphyritic meta-andesite breccia much like the Logtown Ridge formation along the Mother Lode.

1.4 to 1.7 Reworked glacial material.

1.9 Springs on hillside to the left.

2.0 Elevation sign: 5000 ft.

2.3 Andesite breccia and basalt flows of the Taylor Formation and talus slopes to the right.

2.5 Salmon Creek bridge.

2.6 Folded bedded cherts of the Elwell Formation.

2.9 Glacial moraine (reworked) with talus.

3.5 Ruin with chimney on right

BASSETTS (#296)

3.9 Bassett townsite at Howard Creek and road to Sierra Buttes Recreational Area. This area is underlain by granodiorite.

From the vicinity of Bassett to the summit of the pass, the basement rocks are weathered granodiorites of the main pluton or batholith which forms the core of the Sierras. Spheroidal decay boulders can be seen weathering out of the main granitic mass in many places. Preservation of more or less unaltered spheroids in an almost completely weathered matrix is typical of granitic masses in a great many other places as well as the Sierras, and is a phenomenon which has never been adequately explained. Local differences in grain size and mineral composition sometimes account for it. In other instances the effect has no apparent local control (Bowen and Crippen, 1949). The main rock type between Bassett and Sattley is granodiorite.

GEOLOGY MAP 52

Bassetts to Yuba Pass

(Saucedo and Wagner; 1992: Schweickert and Hanson, 1984; Stinson, 1961)

GOLD LAKE AND SARDINE CAMPGROUND

A road connecting with **Gold Lake (#297),** Sardine Creek public camp and other part of the Plumas National Forest joins Highway 49 at Bassets City. Sardine Lake and others in the vicinity are cirque lakes of glacial origin. Except for the moraines to be seen along the North Fork of the Yuba, glacial features are few along Highway 49 and it is necessary to take side trips in order to see examples of glacial topography. A road passable in summer connects with the glacial Packer Lake and resorts. Sardine Lake must be reached by foot from Sardine Creek public camp (Bowen and Crippen, 1949).

4.3 Intersection of Highway 49 and Sardine Pond road.

5.0 San Francisco State University Field Camp to right.

6.3 Sierra campground on left.

6.4 **Haskell Creek bridge (#297).**

7.2 Chapman Creek campground.

7.4 Elevation sign: 6,000 ft.

8.6 Clark Station and road to Chapman Saddle.

9.1 **Yuba-Sutter Fire Camp (#299)** at right.

YUBA PASS (#300)

10.9 Yuba Pass (#300) and Sno Park

The summit of Yuba Pass (#300), at an elevation of 6701 feet, lies in a broad, upland valley which is slowly being dissected at either end by streams of opposing watersheds. The California Sno-Park Camp is to the right (south). The winding grade from Yuba Pass to Sattley affords fine views of Sierra Valley which opens out to the northeast from the vicinity of Sierraville. Sierra Valley is a graben or depressed fault block part of which has been masked by volcanic mountains extruded since the depression of the block. Subsequent erosion and glaciation has greatly dissected the disrupting lave. William Morris Davis believed Sierra Valley to be a continuation of the graben which is partly occupied by Lake Tahoe. The Fault which roughly corresponds with the western edge of the valley crosses Highway 49 immediately west of Sattley. Andesitic gravels can be seen faulted against the granodiorite in places where the contact is not masked by alluvium (Bowen and Crippen, 1949).

YUBA PASS TO QUINCY

GEOLOGY MAP 53

Yuba Pass to Calpine

(Saucedo and Wagner; 1992: Schweickert and Hanson, 1984; Stinson, 1961)

13.4 View of Sierra Valley to the east.

13.8 Leaving Tahoe National Forest.

14.8 Vista Point on right has a small but informative display about the geology of this area.

14.9 Volcanic ash on left.

15.1 Chapman Saddle Road on left.

16.9 Junction of Highway 89 and 49 (#301). The rusting remains of an old sawdust burner is on the right (east).

From the Highway 89-Highway 49 intersection, go north on Highway 89.

Crossing a creek just north of Bench Mark 4954 (SE Section 29), Highway 89 passes from fanglomerate into Quaternary lake sediments.

CALPINE (#302)

At the town of Calpine (S. Section 17, N. Section 20), Highway 89 is underlain by lake sediments.

As the road turns westward from Calpine (#302), Highway 89 traverses Miocene-Pliocene andesitic pyroclastic rocks to the water springs in NW Section 17. Heree the mudflow lies upon Late Jurassic/Early Cretaceous granite. The National Forest boundary line in Section 13 approximates the location of a set of faults marking the east side of Mowhawk Valley. McNair Meadow in Section 14 is underlain by Miocene-Pliocene andestic pyroclastic rocks.

GEOLOGY MAP 54

Calpine to Hayden Mine

(Saucedo and Wagner, 1992; Durrell, 1976b, Potter, 1986)
(Schweickert and Hanson, 1984;Potter, 1986)

The roadway follows **Sulphur Creek (#303).** To the southwest of this creek are glacial till and outwash deposits. To the northeast are lake dposits, Oligocene-Miocene volcanics and Miocene-Pliocene basalt flows.

5.5 Summit, 5441feet.

Highway 49 decends into Mohawk Valley which is bounded on he west by the Mohawk Valley Fault and on the east by an unnamed fault. The valley has the structure of a graben. Mohawk Fault is a northern extention of the East Sierra Fault which marks the eastern side of the Sierra Nevada Mountains. The Lone Pine segment of this failed in a magnitude 7.0 to 8.0 earthquake in 1872. The southern segment of the Mohawk Valley Fault had late quaternary (10,000 to 700,000 years B.P.) displacement (Hawkins et al., 1986).

Eastern boundary fault for Mohawk valley, on the right (east) is mineralized at the **Hayden Mine (#304)**. This mine is in the NE Quarter of Section 32.

GEOLOGY MAP 55

Hayden Mine to Blairsden

(Saucedo and Wagner, 1992; Durrell, 1976b, Potter, 1986)
(Schweickert and Hanson, 1984;Potter, 1986)

At Portola McLears road intersection, to the right (north), Highway 89 is underlain by Quaternary lake sediments.

The town of Clio (#305), at the intersection of Highway 89 and Willow Creek Road (Clio Road, State 40-A Road), is underlain by recent river and quaternary lake sediments. North andeast of the Feather River, the town of Clio rests on Permian andesitic breccia, flows and tuffs of the Reeve Formation

GRAEAGLE TO QUINCY

0.0 Intersection of Highways 89 and 70. Go west on Highway 89.

Between Clio and **Grayeagle (#306),** Highway 89 is built atop Quaternary fanglomerate deposits. These are alluvial deposits washed down from the Ancestral Feather River. They do not extend westward past the Mohawk fault, which suggests that the most recent motion on the

Mohawk Fault is younger than these glacial-age fanglomerates.

BLAIRSDEN (#307)

At the Highway 89-Feather River Highway State 70 intersection in **Blairsden (#307),** rocks are Quaternary lake sediments. The low hills east of Blairsden are an assemblage of volcanic rocks. The predominate volcanic rock type is Miocene-Pliocene andesitic pyroclastics. Above these are Pliocene basalt flows. The volcanic rocks rest upon Reeves Formation and other Paleozoic metamorphic rocks as well as Late Jurassic/Early Cretaceous granodiorite.

GEOLOGY MAP 56

Blairsden to Plumas-Eureka State Park

(Saucedo and Wagner, 1992; Durrell, 1976a, 1976b, D'Allura, 1977)

0.8 Historical marker for J. Jauceson City on left (west). Railroad tracks on left (west).

3.5 Two Rivers Road on left (west) leads to Plumas-Eureka State Park. The Feather River Prep School is to the right (east).

4.5 Landslides.

The Highway 89-Johnsville Road intersection is underlain by Quaternary lake sediments. The Johnsville Road traverses more of these lake sediments and glacial deposits to the townsite and former mining camp of Johnsville.

PLUMAS-EUREKA STATE PARK AND JOHNSVILLE (#308)

Now part of the Plumas-Eureka State Park, Johnsville (#308) was a milling and supply center formthe Mammoth, Plumas and Eureka Mines to the south and east. These mines worked quartz veins in Devonian Sierra Buttes volcanics which include rhyolitic to andesitic flows, breccias, tuffs and cherts. The Sierra Buttes series intruded older Paleozoic rocks of the Shoo Fly Complex. The Plumas-Eureka mill at Johnsville was supplied ore through a mile-long tramway.

GEOLOGY MAP 57

Blairsden to Lee Summit

(Saucedo and Wagner, 1992; Durrell, 1976a, 1976b, D'Allura, 1977)

Between the Johnsville Road-Highway 89 intersection at Blairsden and Two Rivers (SE Section 30, Map 62), the roadway is built atop Quaternary lake sediment. The hills to the northeast (right) are Tertiary volcanic rocks. The hills to the southwest are glacial deposits.

4.1 Road cut in mudflows.

4.6 Camp Layman Road.

Between Two Rivers and the Jackson Creek Campground (NW Section 19), Highway 89 traverses Miocene-Pliocene andesitic pyroclastic mudflows which are capped by Pliocene basalt flows. These volcanics are displaced by a series of NW-SE trending faults spaced 0.5 to 1.5 miles apart. Big Hill in Sections 23, 26 and 27 is representative of the Pliocene lava flows. North of the Jackson Creek Campground, Highway 89 is built on a fault-bounded block of Quaternary lake sediments.

4.9 Mudflows

5.7 Mount Tomba Road on right (east).

The east-west striking ridge west of Cromberg (#309) (north half of Sections 23 and 24) are Miocene-Pliocene andestic pyroclastic rocks. North of Long Valley Creek, Highway 81 is built mostly upon Quaternary lake sediments. To the east, Long Valley Creek is followed by a pack trail. A hike up this trail exposes several fault-bounded blocks of Sierra Buttes Formation, Tertiary gravels, Carboniferous Peal Formation (bedded chert, shale, pillow lavas and tuff) and Late Jurassic/Early Cretacous quartz diorite. Between Sloat Road and Old Sloat Road, Highway 89 passess through a mile wide stock of quartz diorite upon which the Quaternar lake sediments were deposited.

From the Old Sloat Road-Highway 89 intersection to Lee Summit fire station (NE Section 8, Map 64), the roadway approximates a lithologic contact between lake sediments to the south and Miocene-Pliocene andesitic pyroclastic rocks to the north. Along this section of roadway are some small outcrops of Carboniferous-Devonian Taylor Formation (andesitic breccia, tuff and slate), Sierra Buttes Formation and Miocene Lovejoy Basalt.

6.5 **Cromberg (#309)**

7.5 Gill Ranch Road South. Townsite of Sloat is 1 mi. to the west.

8.1 Gill Ranch Road North

8.8 Weathered schist and slate.

9.7 Glacial till in road cut.

10.3 Lake beds.

Between Lee Summit fire station (#309) and the Williams Loop (#310) on the Western Pacific Railway (SE Section 25), Highway 89 traverses a block of Miocene-Pliocene andesitic pyroclastic rocks. These volcanic rocks lie in an east-west en-echelon system of faults that down-drop them into Shoo Fly Complex melange. The northern boundary fault to this volcanic block controls the Squirrel Creek drainage to the northeast.

11.1 **Lee Summit (#309).**

GEOLOGY MAP 58

Lee Summit to Thompson Valley

(Saucedo and Wagner, 1992; D'Allura, 1977; Turner, 1897; Sheeks, 1977)
(Standlee, 1978; Strand, 1972)

11.6 Mudflows.

12.1 Mudflows

12.8 Greenhorn Ranch Road on right (east).

12.9 Spring Garden Overpass for railroad.

WILLIAMS LOOP (#310)

The **Williams Loop (#310)** is a rail Spiral located on the Union Pacific Railroad's (originally Western Pacific Railroad's) Feather River Route through the Sierra Nevada Mountains in north eastern California, connecting the Sacramento Valley to Salt Lake City via the Feather River valley. Located about four miles east of East Quincy, the loop is used to gain track elevation on the WP's eastward climb to its summit at Beckwourth Pass (http://en.wikipedia.org/wiki/Williams_Loop, Sept 24, 2008).

Immidiately west of the Williams Loop, Highway 89 passes into ultramafic and melange facies rocks of Paleozoic Calaveras Complex. At Massack (SE Section 23), Sierra Buttes Formation is exposed along the edge of the hill slopes to the northeast. Passing into the American Valley, the roadway again is built on Quaternary lake sediments that, in this area, were laid down upon Calaveras Complex rocks.

The Chandler Road-Highway 89 intersection is underlain by Quaternary lake sediments. To the north, Johnson Hill is made of andesitic breccia, tuff and slate of the Taylor Formation. To the west of this intersection there are NW-SE trending ridges between the American Valley and Thompson Valley. They are both made of melange rocks of the Shoo Fly Complex. The central axis of Thompson Valley is the location of a westward-dipping thrust fault which shoves Shoo Fly melange facies rocks over Shoo Fly Complex sandstones.

15.9 Serpentine.

16.6 Rest Area on right (east).

18.4 Chandler Road on right (east).

18.6 Greenhorn Creek.

Between the Thompson Valley (#313) and Quincy (#314), Highway 89 is built on Shoo Fly Complex sandstones and Quaternary lake sediments. The lake deposits are the remnants of pluvial lakes that were present throughout the region in glacial periods.

In the northeast quarter of Section 20 is the intersection of Highway 89 and the Quincy-La Porte Road. This road lead south toward La Porte, following Thompson Creek.

19.5/0.0 La Porte Road (U.S.F.S. Road 120 on left (south). Reset odometer. Proceed west on Highway 80.

SIDE TRIP TO LA PORTE

Where the roadway makes a sharp bend to the east, at the west edge of Thompson valley, alluvial fan deposits are exposed.

The western edge of Map 65 is at the approximate location of the thrust fault, discussed above, which places Shoo Fly melange rocks of ver Shoo Fly sandstones, siltstones and slates. The road and Thompson creek cut through the melange facies rocks to the bend in the La Porte Road in the northwest quarter of Section 34. From that point to the sharp switchback in the La Porte Road in the southeast quarter of Section 33 the roadway (and Thompson Creek) are cut into Shoo Fly sandstones.

At the switchback, a fault is crossed which brings the Shoo Fly Complex rocks to the north against Miocene-Pliocene andesitic pyroclastic rocks to the south.

At the ridgecrest in Sections 4 and 3, southeast of **Cutler Meadow (#314),** the Quincy-La Porte Road crosses through Miocene Lovejoy Basalt. From the ridgtop to the Middle Fork of the Feather River, the road cuts through Shoo Fly Complex sandstone and Miocene-Pliocene andesitiec pyroclastic rocks. Between Nelson Point (#315), on the river, and the western edge of Map 68 (SW Section 21), the Quincy-La Porte Road is underlain by sandstones, siltstones and slates of the Shoo Fly Complex. Between Nelson Point and Finger Board, the road parallels “The Hogback”.

GEOLOGY MAP 60

Cuttler Meadow to Onion Valley

(Saucedo and Wagner, 1992; Hietanen, 1976; Standlee, 1978)

The swath of land west of Bachs Creek Ridge (#316) and Bachs Creek (Section 7 and E1/2 Section 18, and including Little Volcano (#317) and Limestone Point (#318, NW Section 17) and Quartz Point (#319, E1/2 Section 20) is a belt of Shoo Fly melange terrane with three small exposures of limestone. This melange belt is six miles long and up to one mile wide. It is in fault contact, to the east and west, with Shoo Fly Complex sandstones, siltstones and slates. Hottentot Creek, south of the Middle Fork of the Feather River, in Sections 20 and 29, approximates the western fault contact of this melange belt. The Sugar Pine Mine (#320, SE Section 17) lies along the eastern boundary fault of the melange terrane block. There is a twin belt of mines between Crescent Hill (#321, SE Section 11) and Finger Board (#322, NW Section 32). The mines in these belts are in the Melones Fault Zone:

Western Part of Melones Fault Zone "Goodyear's Bar Fault"	Eastern Part of Melones Fault Zone "Melones Fault"
Egbert Mines (NE Section 14)	
Crescent Hill Mine (NE Section 14)	
Wilson-Gomez Mine (NE Section 24)	Belfrin Extension Mine (NW Section 19)
H & G Mine (SW Section 24)	Belfin Mine (SW Section 30)
Gold Point Mine (NW Section 30)	

In this area, Shoo Fly Complex rocks are east of the Melones Fault and generally forms the footwall for the mines. Feather River Peridotite Belt rocks are to the west of the Melones Fault and generally form the hanging wallsfor these miners.

The Egbert and Crescent Hill mines are associated (spatially) with Paleozoic amphibolite of the Feather River Peridotite Belt and Lovejoy Baalt.

South of the Middle Fork of the Feather River, the Melones Fault splits into two branches. The western branch is the northward projection of the Goodyear's Bar Fault. The western branch is a northward projection of the Melones Fault. Between these faults is Peridotite of the Melonez Fault Zone and small bodies of Shoo Fly Complex sandstone. Both units have been covered by Miocene-Pliocene andesitic pyroclastic rocks. Below the volcanic rocks are occasional exposures of Tertiary gravels. These gold sources are further concentrated by the Middle Fork of the Feather River to form recently formed placer gold deposits at Minerva Bar (#323, center of midline between sections 13 and 24) and Rich Bar (#324, near the common corner of Sections 17, 18, 19 and 20)

East of Finger Board (#322), at the western end of Washington Ridge is a road intersection of the Quincy-La Porte road with a road which leads westward to Cleghorn Bar (#325). Stay on the Quincy-La Porte Road and go south toward La Porte.

From the Cleghorn Bar Road intersection to Onion Valley, the Quincy-La Port Road approximates the location of the Melones Fault on the eastern flank of Washington Ridge. To the east of the Melones Fault are Shoo Fly Complex sandstones. To the west are Feather River Peridotite Belt rocks overlain by Miocene-Pliocene andesitic pyroclastics.

ONION VALLEY (#326)

Onion Valley (#326, SE Section 5) lies atop the Melones Fault. From Onion Valley to the unnamed mine 0.1 miles south of the center of Section 8, the Quincy-La Porte road is built atop Peridotite of the Melones Fault Zone. The unnamed mine in SW corner of Section 8, and the unnamed mine in the NE corner of Section 6 lie on the northward projection of the Goodyear's Bar Fault named the Rich Bar Fault.

The Onion Valley Placer Diggings in Sections 5 and 6 are recent enrichments of older (buried) Tertiary Gravels.

GEOLOGY MAP 61

Cuttler Meadow to Onion Valley

(Saucedo and Wagner, 1992; Hietanen, 1976, Edelman, 1986)

The Plumas-Sierra County line is along Gibsonville Ridge (#327, Sections 17 and 19). This ridge is capped by Miocene-Pliocene andesitic pyroclastic rocks. The inactive unnamed mine in NW Section 19, near the Plumas-Sierra county line, is on the Rich Bar- Goodyears Bar Fault. Here the fault juxtaposes Paleozoic amphibolite of the Feather River Peridotite Belt to the west from Shoo Fly Complex sandstones to the east. From this point to **Gibsonville (#328)** , the Quincy-La Porte Road is built atop Miocene-Pliocene andesitic pyroclastic rocks.

Union Keystone Mine (SE Section 19), Gibsonville placer diggings (Section 30), Taber Mine (SW Section 30 on Gibson Creek), and **Thistle Shaft (#329)** , NW Section 36) work Tertiary gravels that lie below the Miocene-Pliocene andesitic pyroclastics. Port Vine Ridge (Sections 24, 18 and 8) and Table Rock (SE Section 5) to the south are also capped by pyroclastics. The area between Cedar Grove Ravine and the ast Branch of Slate Creek are Tertiary Gravels with no volcanic cover. They lie upon Paleozoic amphibolite of the Feather River Peridotite Belt. The amphibolite belt is confined between the Goodyears Bar Fault to the east and the Dogwood Peak Fault to the west.

GEOLOGY MAP 62

Thistle Shaft to La Porte

(Saucedo and Wagner, 1992; Hietanen, 1976, Edelman, 1986)

Southwest of Gibsonville (#328),beneath the volcanics and Tertiary gravels, is Shoo Fly Complex sandstone, siltstone and slate. Near the Thistle Shaft (#329) on Wallace Creek, the auriferous gravels are deposited upon Paleozoic amphibolite

Quincy-La Porte Road, from the Thistle Shaft to a point 2 miles east of the La Porte (#333) town site, is underlain by Miocene-Pliocene andesitic pyroclastic rocks. Goat Mountain (#330, S1/2 Section 34) and the hill in SW Section 33 (surrounded by waters of Little Grass Valley Reservoir, #331) are remnants of Pliocene andesite flows.

The Dogwood Peak Fault is in the flooded western arm of **Little Grass Valley Reservoir (#331)** and strikes southward along the Little Grass Valley Trail (W Section 4, W Section 9), cuts through the Claybank and **Independence mines (#332)** , SE Section 16, and then along the ridge west of Spanish Ravine Creek (NW Section 22). This fault juxtaposes Calaveras Complex and Central Belt metamorphic rocks to the east from Slate Creek Complex metavolcanics to the west. The townsite of La Porte is built upon these metavolcanic rocks.

LA PORTE (#333)

About an hour's drive south of Quincy is the historic community of La Porte and the nearby Little Grass Valley Reservoir. A former gold mining town, La Porte today attracts numerous visitors to its superior campsites, fishing holes, and swimming areas.

The area also is well-known for its winter recreation and was the site of the nation's first organized downhill ski racing on 12-foot "snowshoes" in the late 1800s. The La Porte area hosts miles of terrain for snowmobiling and cross-country skiing as well as staging areas and warming huts.

The community features the historic Union Hotel Sierra Retreat (open for groups), along with cabin rentals, a resort, a general store, deli, gas station, gift store, tavern, and a small museum. Boat, jet ski, bike, ATV and snowmobile rentals available. La Porte is accessible from Quincy via the La Porte/Quincy Road (unplowed in winter) or year-round from Marysville via Highway 20
and County Road E-21. (from http://www.plumascounty.org/Communities/LaPorte.htm, Sept. 23, 2008).

GEOLOGY MAP 63

Thompson Valley to Blackhawk Creek

(Saucedo and Wagner, 1992; Hietanen, 1976, Edelman, 1986)

0.0 Return to the intersection of the La Porte Road and Highway 89.

0.1 Quincy town limit.

3.0 Quincy Junction Road.

QUINCY TO TAYLORSVILLE

QUINCY (#334)

4.0/0.0 Intersection of highways 79 and 80 at west end of Main Street. Reset odometer, proceed north toward Marysville.

0.6 Cross Spanish Creek.

1.0 Golden Ranch Road.

1.6 (MP 41.50) Purdee Lane to **Elizabethtown Site (#367)** on left (north).

2.0 Road crest in weathered metamorphic rocks.

2.6 to 2.8 Light tan-buff slate.

3.5 **U.S. Forest Service Mount Hough Ranger Station (#368)** on left (west).

3.8 Chandler Road

4.1 **Blackhawk Creek (#369).**

GEOLOGY MAP 64

Blackhawk Creek to Arlington Bridge

(Saucedo and Wagner, 1992)

4.7 Old Highway on right (east).

5.2 to 5.5 Massive schist outcrop.

5.8 Old Highway on right (east).

6.1 Roundhouse Road.

6.6 Keddie Road in grey-blue slate to Keddie (#336).

7.4 Dual railroad tressels on right over river.

7.8 Spanish Creek.

8.4 Railroad tressel on right (east).

8.7 Quarry Road on the right (east).

8.75 Slate.

10.2/0.0 Intersection of Highways 89 and 80 (#337). Proceed right (north) on Highway 89 toward Greenville.

0.1 Rapids on right (east) in schist and slate.

1.2 Placer mining operation working recent river gravels on the right (east) side of Indian Creek.

2.2 **Travertine deposit and archaeology site (#338)** across Indian River on the right (east) at Indian Falls .


Figure 91. Indian Falls Travertine, 2008.

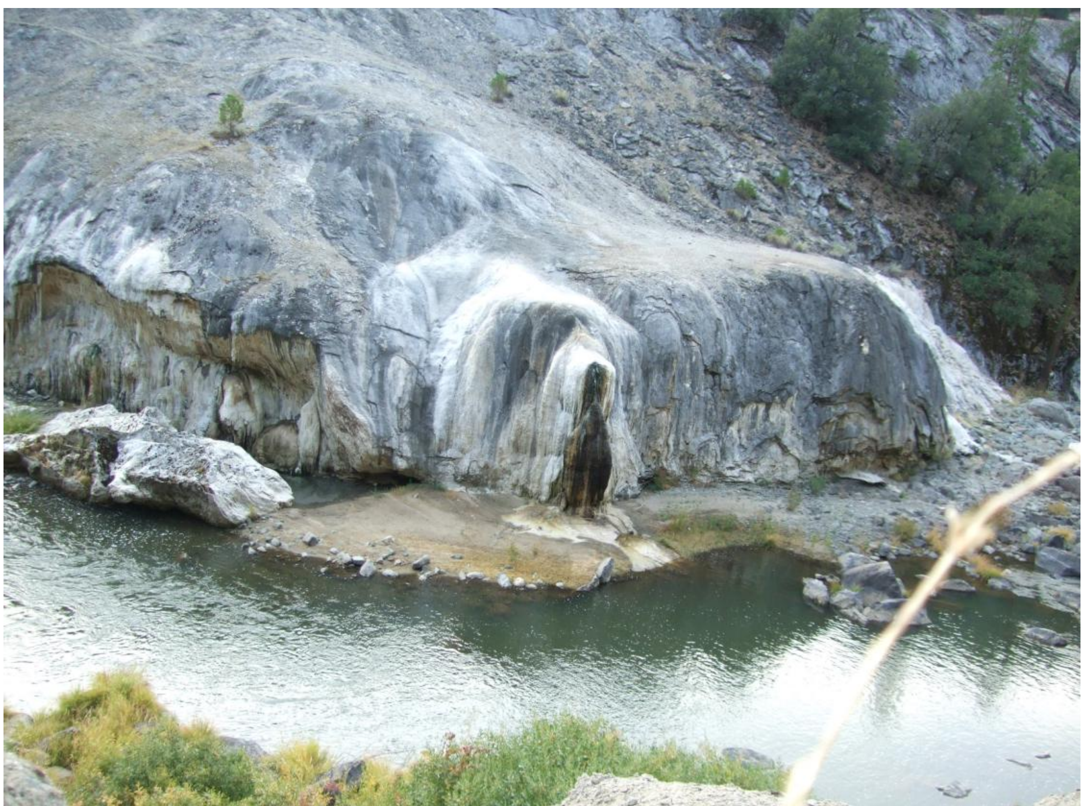


Figure 92. Indian Falls Travertine, 2008.

2.7 Indian Falls Road on left (west).

3.3 (MP 12.00) Greenstone.

6.2/0.0 Intersection Highway 80 and County Road A22. Turn right (east) on Road A22, across railroad tracks, toward Taylorsville.

0.1 Cross Indian Creek on **Arlington Bridge (#370).**

GEOLOGY MAP 65

Arlington Bridge to Foreman Ravine

(Saucedo and Wagner, 1992)

0.8 Indian Valley is on left (north).

1.7 Mount Hough Road on right (south).

2.8 Intersection of Arlington Road and Johnston Road. Keep on Arlington Road.

TAYLORSVILLE (#339)

4.8/0.0 Main Street and Nelson Road in Taylorsville (#339).
Reset odometer and proceed east on Main Street.

Figure 93. Indian Valley Museum, 2008.


Figure 94. Stamp Mill, Indian Valley Museum, 2008.

SIDE TRIP TO THE ENGELS MINE

GEOLOGY MAP 65

Arlington Bridge to Foreman Ravine
(Saucedo and Wagner, 1992)

0.0 Taylorsville Campground at Rodeo Grounds. Go north on Road 112.

0.8 Rock quarry on the right (east).

1.3 Intersection Roads 114 and 112. Take Road 112 (North Arm Road) northwest.

2.4 North Foreman Road.

2.6 Cross **Foreman Ravine (#371).**

GEOLOGY MAP 66

Foreman Ravine to Superior Mine

(Saucedo and Wagner, 1992)

2.7 Road to right (east) goes to Green Flat via Beardsley Grade. Road follows east side of Cooks Creek in Indian Valley.

5.1 Cross Peters Creek

6.6 Salvage logging from fire of 2008 on right (east).

6.9 **Tailings (#356).** Lights Creek is northwest of these tailings. The row of trees at the south end of the tailings mark the location of the tailings dam. Large trees on this tailing pile that had been cut had 29 growth rings in October, 2008. These are mill tailings from the Superior and Engels mines upstream. From the tailings northward, the road is built on the old railroad bed for the Indian Valley Railroad. The railroad was built in 1917 and dismantled in 1938.

7.8 Intersection of North Arm Road and Mountain Drive Road. Keep to the right and continue northward on Mountain Drive Road.

8.0 Cross Fred's Creek.

8.4 Moonlight Valley Road on left (west). This road goes 7 miles northwest to Moonlight Valley where Nevoro was conducting core drilling operations in October, 2008.

8.6 Salvage logging from fires of 2008 on right (east).

9.7 **Superior Mine (#372)**

10.5 Cross Warren Creek.

10.6 **Tailings (#357).** These are on the right (east).

11.1 Cross Superior Ravine.

11.2 Take Road east and south to Engels Mine (#359).

THE MOONLIGHT AND ENGELS MINES (#358)

11.6 Engels Mine mill ruins are uphill on the right (east)

11.7 The cement structure on the right (east) is the safe for the warehouse building which is now removed.

Figure 95. Engels Mine in Upper Camp (Indian Valley Museum collection)

The first mill in the United States to use only the flotation process to concentrate its copper ore was completed in 1914 at the Engels Mine in Upper Camp. It was built by Minerals Separation American Syndicate (1913) Ltd. The mill was designed at 150 tons-per-day and was milling 400 tons-per-day when it closed on November 1, 1919 in lieu of the larger and more favorably located Superior Mill at Lower Camp. (Courtesy Indian Valley Museum, October, 2008)

Figure 96. Superior Mill, Engelmine, Lower Camp, 1923. (Indian Valley Museum collection)
Numbers in photograph refer to: (1) Superior Mine (2) Superior Mill (3) Machine Shop
(4) Office and Warehouse (5) Indian Valley Railroad Depot (6) Power House

Figure 97. Engels Mine Mill, 2008.

The Superior Mill at Lower Camp began operation on November 1, 1917. The Engels Mill at Upper Camp closed on November 1, 1919. The consolidated operation milled 1,000 tons-per-day from the Engels and Superior mines until July 15, 1930 when the mines and mill were closed due to the low price of copper. Ore was delivered to the mill from the Engels Mine first by the No. 6 Level aerial tramway then by the Superior Electric Railroad. From the adjacent Superior Mine ore was hoisted directly from the mine to the mill. During their operation from 1914-1930 approximately 4,700,000 tons were mined from the Engels and Superior mines and milled producing 160,170,000 pounds of copper and substantial values in gold and silver. Engels Copper Mining Company was a substantial employer during World War I and the 1920's, supported the local economy and paid dividends to its shareholders (Norman Lamb, and Indian Valley Museum, 2006).

A mile north of the Engels Mine Mill is the site of the Engels smelter. It was dismantled shortly after it was built because the mining company decided to beneficiate the ores by floatation instead of by smelting. The smelter was built near the portal for the No.10 Level. In 2008 there were a collection of storage sheds that were being used to house core.

Figure 98. Engels Smelter site, 2008.

Frederick Klamp, vice president of Honolulu-based German merchant banking firm H. Hackfeld and Company, Ltd., and owner of sugar plantations, and Elmer Paxton of Alexander and Baldwin, a Hawaiian-based owner of sugar plantations, visited the smelter site and Engels Mine in 1910. Frederick Klamp raised the money from his friends and associates in Hawaii to build the infrastructure for the failed smelter project. Pictured in this photograph, taken during the visit to the smelter site then under construction, are, from left to right, Louise Girard, Harriet Paxton, William Engels, and Frederick Klamp. They came on the trip to meet Williams Engels, age 52 and thought to be a very eligible bachelor. In 1914, Elmer Paxton became the general manager and treasurer of Engels Copper Mining Company and built the Engels flotation mill at Upper Camp. Frederick Klamp became president of the company in 1922 after ousting Henry Engels in a proxy fight. (Courtesy of Norm Lamb.)

Figure 99. Engels Smelter, 1910. From McCutchon, 2008:76 and Norm Lamb.

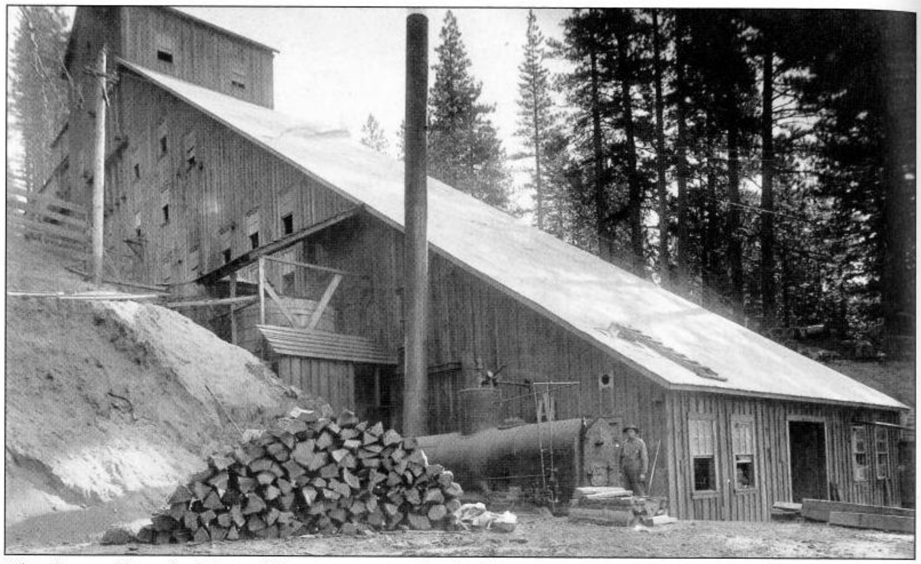


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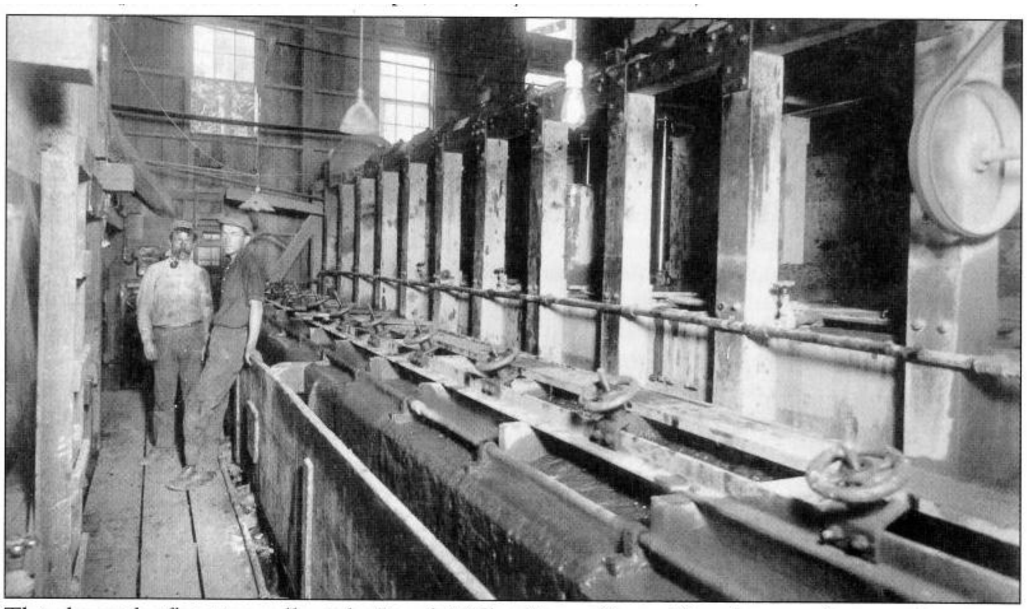
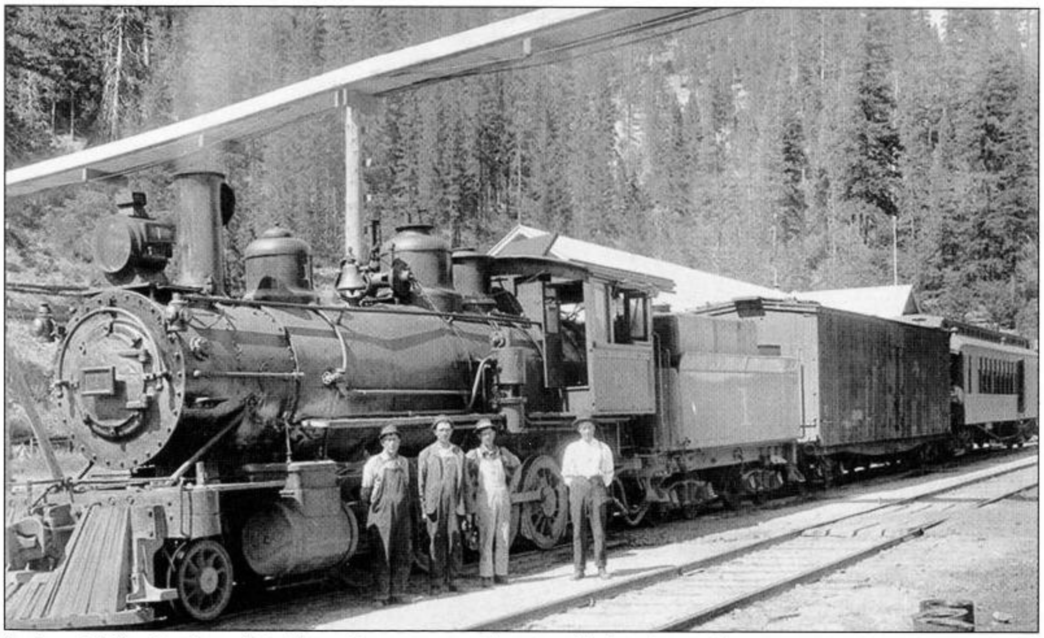
Figure 100. Engels Floatation Mill, 1914. From McCutcheon, 2008:78 and Norm Lamb.



This shows the flotation cells at the Engels Mill at Upper Camp. Flotation was the most important development of the 20th century for the mining industry. It opened new mineral resources and averted an industrial crisis with the exhaustion of high-grade mineral deposits. Basically flotation "floats" the minerals on a water bath, where they are collected, dried, and sent to the smelter for final processing. Shown here are Will Gruss (left) and Charles Scott Haley. (Courtesy of Norm Lamb.)

Figure 101. Engels Floatation Mill bank of cells. From McCutcheon, 2008:78 and Norm Lamb.



Indian Valley Railroad Baldwin locomotive No. 1 pulls freight and passenger cars in front of the Engels depot at the Engels mine Lower Camp, westbound for Paxton to connect with the Western Pacific Railroad. The overhead trestle in the photograph carried steam from the heating plant to the Superior Mill on the hillside to the right. Note the carbide cans in lower right corner of the photograph being recycled as trash cans.

Figure 102. Indian Valley Railroad Baldwin Locomotive No. 1. From McCutcheon, 2008:83 and Norm Lamb.

The following was taken from the Nevoro website at http://www.nevoro.com/moonlight/mineralization.html on (Oct. 4, 2008):

The Moonlight Copper project is located 140 km northwest of Reno, Nevada in Plumas County, California. It consists of 289 wholly owned contiguous unpatented mining claims, 8 optioned contiguous unpatented mining claims, 36 patented mining claims and 6 fee property claims – together comprising 6,857 acres, or almost 28 km^2 of 100%-owned mineral rights.

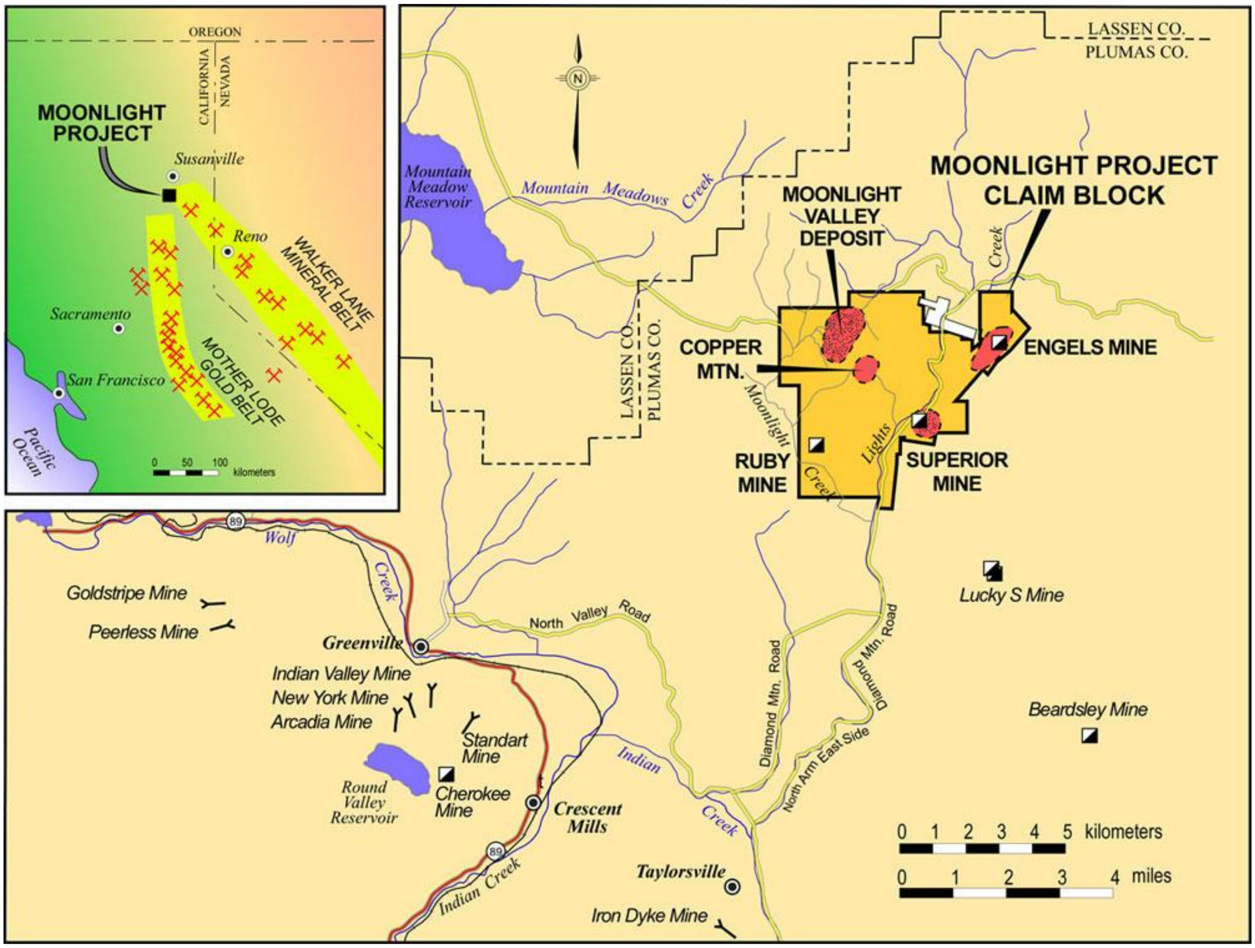


Figure 103. Location and Project Area Map for the Moonlight-Engels Project.

The Engels Mine and surrounding mining properties are currently under lease or are owned by Nevoro Inc. Nevoro's principle asset is the Moonlight copper-gold-silver project in northeastern California

Moonlight is situated in the Lights Creek mineral district at the northern terminus of the Walker Lane mineral belt. The Lights Creek mineral district is the second most productive copper region in California and is known for many high-grade copper-gold-silver mines.

In the 1960s, Placer Amex completed US$6 million worth of exploration (equivalent to approximately US$35 million in today's dollars) that included 43,000 m of diamond drilling. Placer Amax held the project from 1971 until 1994 when the company's focus shifted to gold.

Moonlight has current NI 43-101 compliant indicated resources of 161.57 million tons averaging 0.324% Cu (at 0.2% cutoff), 0.003 oz/ton Au and 0.112 oz/ton Ag, plus inferred resources of 88.35 million tons averaging 0.282% Cu, 0.003 oz/ton Au and 0.089 oz/ton Ag.

Moonlight has four advanced- and three exploration-stage targets for evaluation. Nevoro intends to initiate exploration at Moonlight following the closing of the Sheffield acquisition on or before July 31, 2008.

Moonlight is at the northern terminus of the Walker Lane mineral belt in Plumas County, California. Mineralization at the Moonlight project is hosted by a large and complex Jurassic intrusive stock regionally located near the triple point junction of the Cascade, Sierra Nevada and Basin and Range provinces.

The mineralization has been classified as a porphyry-copper type system but does not exhibit many features characteristic of these systems. Additionally, it is an unusual low-sulfide system containing only sparse amounts of acid-generating sulfide minerals such as pyrite.

Copper mineralization is widespread over most of the 28 km^2 Moonlight area, occurring as discrete large high-grade veins, veinlets and extensive disseminations in the wallrock between the veins. The wallrock alteration is far less conspicuous than typical porphyry-copper systems due to the paucity of acid-generating sulfide minerals, and many low-grade copper occurrences in the region have not been recognized in the past due to the lack of conspicuous surface alteration.

The primary hypogene copper minerals at Moonlight consist mostly of bornite, chalcopyrite, and chalcocite which are associated with considerable amounts of magnetite and specular hematite. The secondary copper minerals – malachite, azurite, and chrysocolla – occur in the oxide zone, which extends from the surface to a depth of 50 m or more. The secondary minerals appear to be the products of in-situ oxidation of the primary copper minerals and not the products of supergene enrichment, which is of very limited extent. The lack of supergene enrichment is attributed to the lack of acid-generating primary sulfide minerals. The presence of abundant tourmaline, roof pendants, country rock clasts and other features offer evidence that the mineralization exposed on the project occurs near the roof of the intrusive complex, in which case the mineralization can be expected to persist to considerable depth.

The Moonlight Project was advanced by Placer during the 1960s and 1970s during which the company completed geological mapping, geophysical and geochemical surveys and 43,000 m of core drilling. Moonlight holds seven potential Cu-Au-Ag open pit targets, including the most advanced targets – Moonlight Valley, Engels Mine, Superior Mine Area and Copper Mountain.

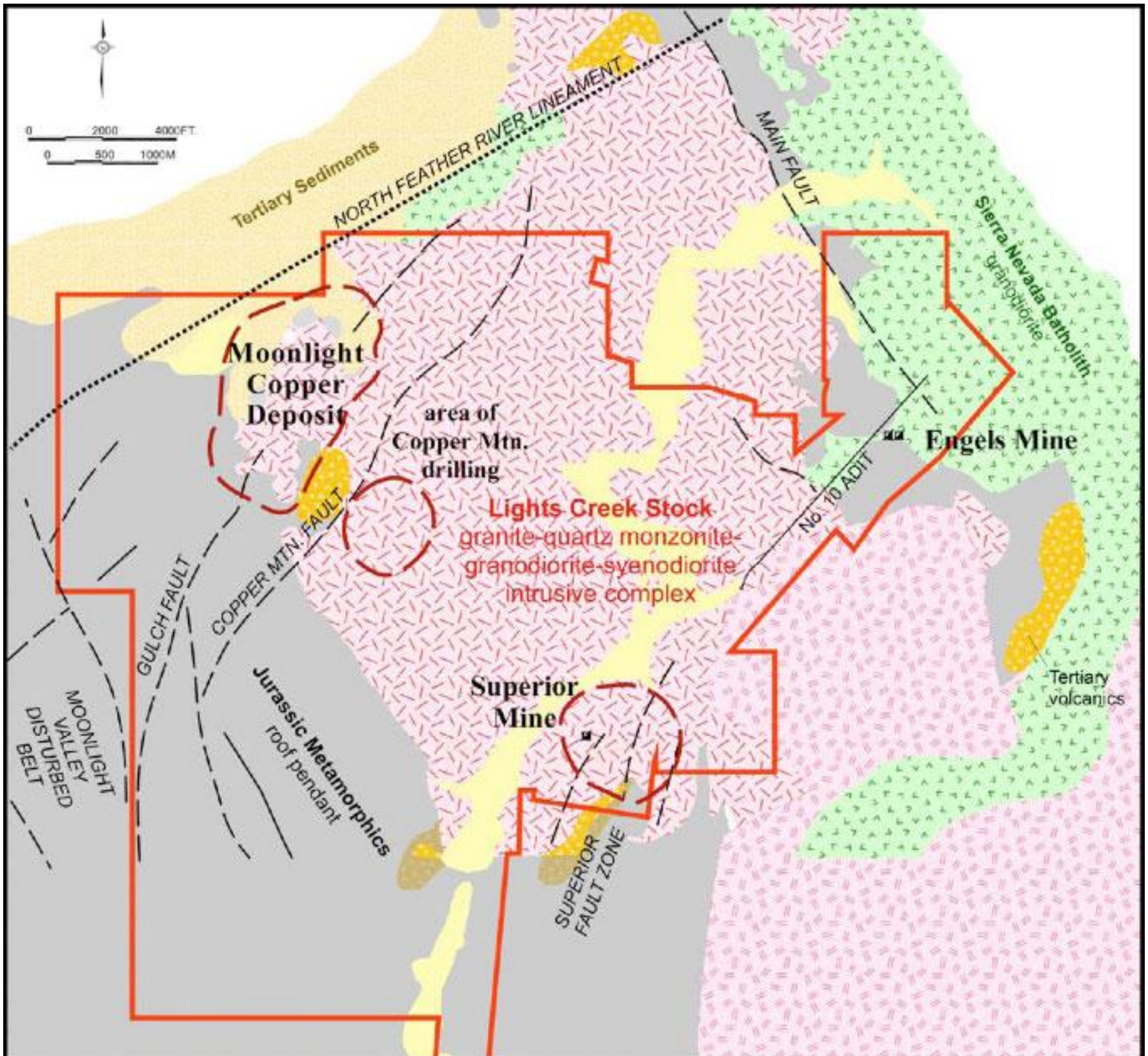


Figure 104. Geology map for Moonight-Engels project.

Moonlight Valley

The most intensely explored area on the project is the Moonlight Valley deposit, which contains National Instrument ("NI") 43-101 compliant mineral resources defined by 199 historical core holes (30,300 m) and 14 recent confirmation core holes (3,400 m) as reported in "Technical Report and Resource Estimate on the Moonlight Copper Property, Plumas County, California for Sheffield Resources Ltd.", by George Cavey, P.Geo., and Gary Giroux, P.Eng, dated April 12, 2007. The current NI 43-101 mineral resources are as follows:

Cut off (Cu %)	Indicated Mineral Resource				Inferred Mineral Resource			
	Tons > cutoff	Cu (%)	Au (oz/t)	Ag (oz/t)	Tons >cutoff	Cu (%)	Au (oz/t)	Ag (oz/t)
0.20	161,570,000	0.324	0.003	0.099	88,350,000	0.282	0.003	0.089
0.25	114,570,000	0.366	0.003	0.112	48,820,000	0.329	0.003	0.107
0.30	76,150,000	0.413	0.003	0.124	23,720,000	0.390	0.003	0.118

These indicated and inferred resources do not take into account the oxide mineralization drilled at the Moonlight Valley or the historic resources defined at the Superior Mine Area.

The 2007 Technical Report notes that Placer recognized significant amounts of copper were lost during their drilling and because of this the copper grades estimated from the drilling – which are the grades used in the NI 43-101 resource estimation – are conservative and apparently understated. Sheffield’s recent drilling recovered 44% more copper in their Moonlight Valley drill holes than in the adjacent Placer drill holes. Reasons offered for the historically understated drill grades include improper orientation of the historical drill holes, small BX-size core in the historical drilling resulting in very poor recoveries, loss of copper minerals in the historical drilling as confirmed by Placer’s own comparison sludge sampling, possible analytical issues, and perhaps other items as well. This means that the Moonlight Valley deposit, which remains open at depth and along strike, is potentially larger than currently known and may also be potentially richer than indicated by the historical drilling.

The Moonlight Valley sulfide deposit, which contains the previously mentioned mineral resources, remains open laterally and to depth. Mineralization extends from the surface to a vertical depth of at least 600 m, which is the length of the deepest hole yet drilled on the target. This hole was mineralized throughout its length (averaging 0.185% Cu) and bottomed in 0.3% Cu. The limits of the deposit are unknown. Additionally, the historical work by Placer, and reconfirmed by Sheffield, indicates that the area also contains substantial near surface oxide copper mineralization, comprising a shallow copper target possibly amenable to low-cost SX-EW extraction. This oxide mineralization was not included in the resource reported in the 2007 Technical Report

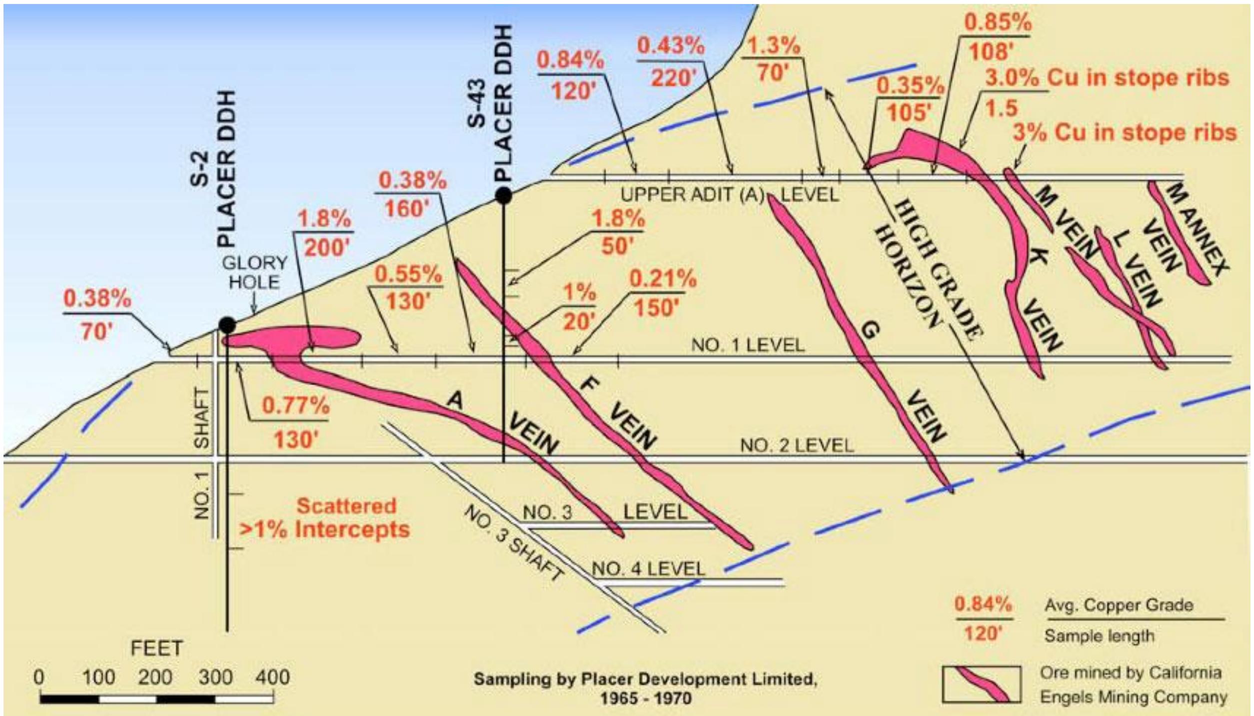


Figure 105. Cross section showing drill locations, drifts, and orebodies at the Moonlight-Engels project.

Engels Mine

The Engels mine, a historically important producer, is located on private patented ground approximately 4.5 km east of Moonlight Valley. It is currently being drilled by Sheffield to define high-grade mineralization, which might be mined as a "fast-track" starter operation. Mineralization consists of high-grade bornite-chalcopyrite-magnetite occurring in a pipe-like body, 50 to 100 m wide, more than 200 m long, and extending over a vertical range of at least 700 m. Sheffield's recent 32-hole drilling program at Engels demonstrates high-grade oxide copper mineralization (typically 1% to 2%) from surface to depths of more than 200 m over intervals ranging from a few m up to 102 m.

Superior Mine Area

The Superior mine area, is on private patented ground approximately 3 km southeast of Moonlight Valley. It consists of a large stockwork of parallel high-grade bornite-chalcopyrite-magnetite veins from 2.5 to 6.0 m thick and separated by 30 to 120 m of wallrock containing disseminated copper in the 0.3% to 0.8% range. Placer examined Superior as a possible open-pit target, drilling 96 core holes to an average depth of 160 m and estimating an historical resource of 43 million tons grading 0.56% Cu (with a 0.3% Cu cutoff), as summarized in the 2007 Technical Report. Although these historical resources are considered relevant, they do not follow the requirements for reserve and resource estimations outlined in NI 43-101 and should therefore not be considered current. Not included in these historical resources are substantial quantities of higher grade material remaining in the Superior mine underground workings below open-pit depth. The configuration of mineralization, rock quality and the abundant mine workings could make the Superior deposit amenable to very low cost underground mining methods

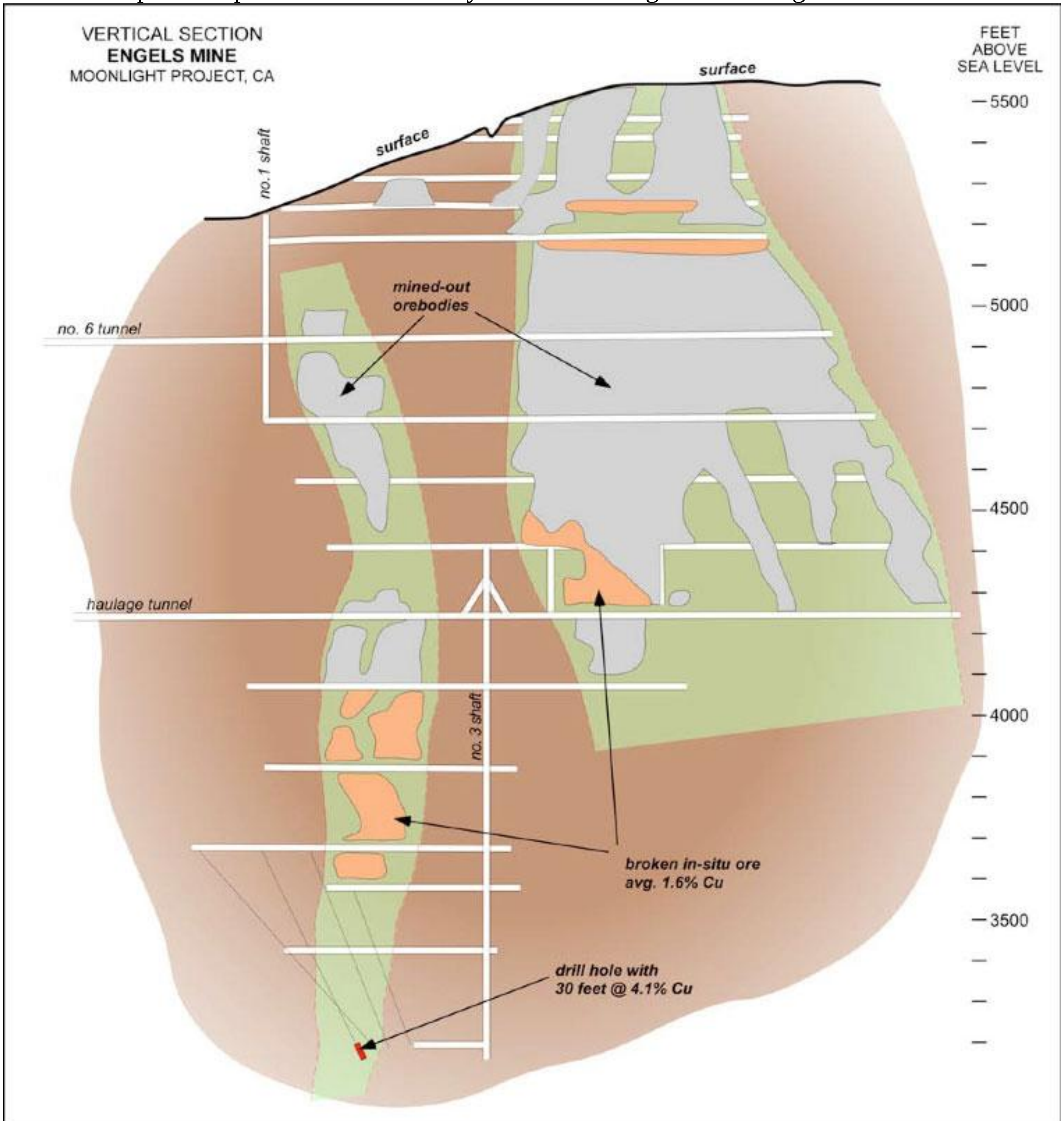


Figure 106. Vertical Section, Engels mine.

Copper Mountain

Copper Mountain is one km southeast of Moonlight Valley. Placer drilled 24 vertical holes (3,670 m) on this target, reportedly intersecting significant intervals of 0.3 to 0.4 % Cu to depth.

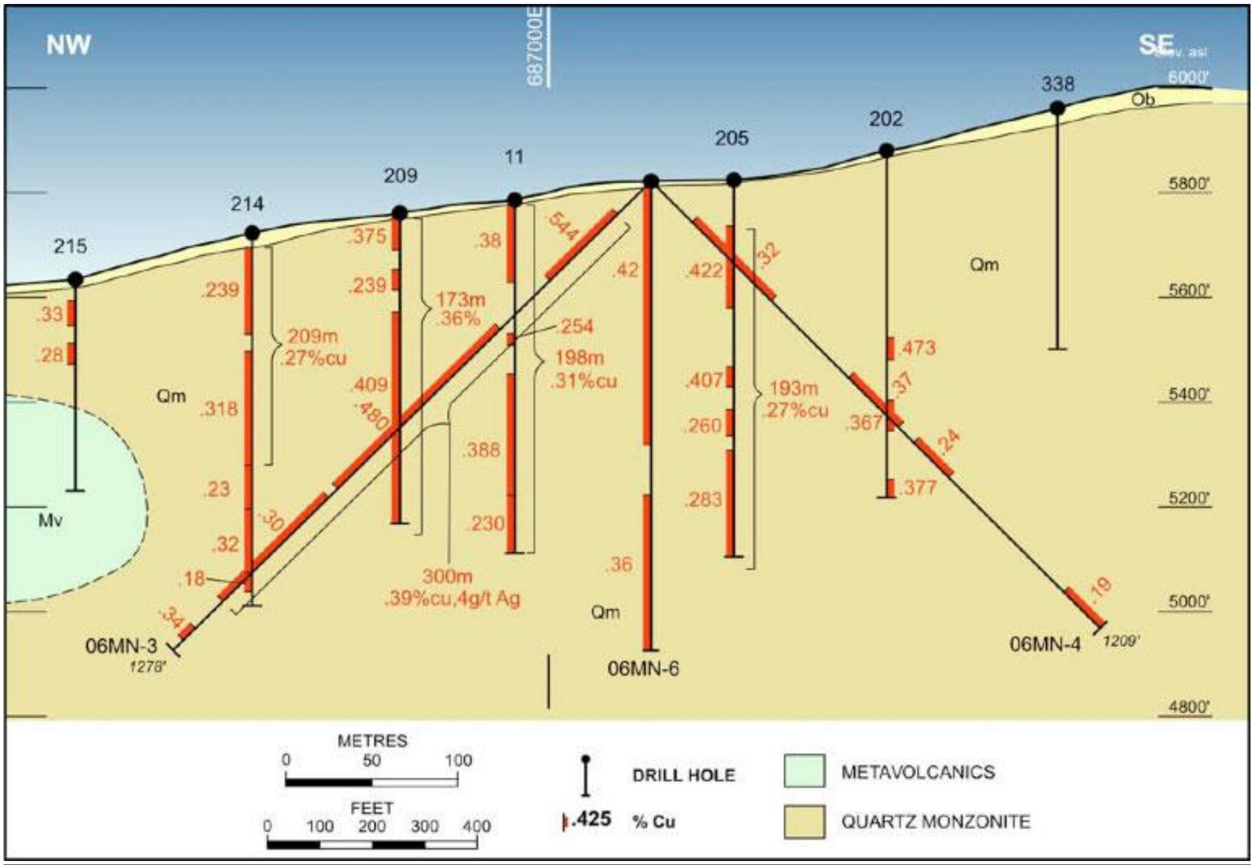


Figure 107. Cross section showing drill hole projections and assay results.

Other Targets

Other targets partially tested by Placer, but not yet tested by Sheffield, include Moonlight South, a possible high-grade target in or beneath a large pendant of metavolcanic country rocks which overlies the southwest-plunging Moonlight Valley porphyry system. The pendant contains widespread specular hematite, quartz veinlets and scattered copper oxides, possibly representing an alteration-mineralization halo above a high-grade zone trapped within or beneath the pendant, a situation generally analogous to that reported from some important districts such as Pebble, Alaska, and Oyu Tolgoi, Mongolia. Three grab samples collected by Sheffield from the dump of the collapsed Ruby mine located within this pendant averaged 5.28% Cu, 1.87 g/t Au and 211 g/t Ag. Other outlying targets of future interest include Sulphide Ridge, Gossan Ridge, Blue Copper and others.

MOONLIGHT PROJECT EXPLORATION POTENTIAL

The Moonlight project is underlain by an intrusive complex of large size, extending to unknown depth, and contains high-grade structurally controlled mineralization associated with an unusual low-sulfide type of disseminated mineralization that could easily be overlooked in reconnaissance examinations. The copper mineralization is widespread over an area of at least 30 km2, within which several targets of promising size and grade have already been defined, and other targets have been identified which warrant additional exploration.

It is Nevoro's intention to accelerate the work underway by Sheffield in order to rapidly advance and expand the Moonlight Valley resource. The exploration target objective is a 400 to 600 million tonne copper deposit grading 0.4 to 0.6% Cu, however these potential quantities and grades are conceptual in nature. The historical and current exploration work done to date are insufficient to define this target and it is uncertain if further exploration will result in the discovery of any mineralization of economic importance.

Nevoro also plans to: (a) continue defining the potential SX-EW amenable, high-grade oxide copper mineralization on the Moonlight Valley and Engels targets; (b) advance the high-grade Superior target to a possible resource stage; and (c) explore and advance the several other scarcely tested copper targets on the project and in the surrounding region.

TAYLORSVILLE TO GATE PLACE AND THE WALKER MINE

GEOLOGY MAP 68

Taylorsville to Genesee

(Saucedo and Wagner, 1992)

0.0 Taylorsville, town center.

0.2 Indian Valley Museum.

0.21 Cross mining ditch.

0.6 Taylorsville Campground.

3.6 Gaging Station on Indian Creek. Area underlain by glacial till.

5.6 Metavolcanics. Sand bar from 1997 floods can be seen on the south side of Indian Creek.

6.6 **Genesee townsite (#340).**

GEOLOGY MAP 69

Genesee to Oliver Creek

(Saucedo and Wagner, 1992)

0.0 Intersection of Beckwourth-Greenville Road and Walker Mine Road. Go south on the Walker Miner Road. Go west on unmarked Walker Miner Road along the top-NE1/4 of Section 16. The road follows Little Grizzley Creek.

0.2 Cross Indian Creek. After crossing creek, keep right and go west on Walker Mine Road (Road 112).

0.7 Neff Family Ranch on right (north).

1.7 Glacial Till

2.0 Glacial Morain with metavolcanic clasts.

2.4 Salvage Logging area to the right (northeast).

2.8 Metavolcanics

2.85 Road on right to **Gaging Station (#351)** on Little Grizzley Creek.

3.2 Road forks. Stay to the right (west) and go southwest.

3.3 Road on right (west).

3.5 Glacial morain

3.9 Glacial till with metavolcanic clasts.

4.2 Metavolcanics

4.55 Cross creek.

4.6 Cross creek

5.1 Salvage logging area to the right (west) and slates.

5.2 Grey slates of the Taylor Formation.

5.4 Greenstone

5.7 Green slates of the Goodhue Formation metavolcanics, (Pzv, to east) at fault contact with Taylor Formation (to west).

5.9 Fire staging area to the left (east).

6.1 Area is underlain by Permian Goodhue Formation.

6.4 Cross unnamed creek.

6.6 Outrcrops of Goodhue Formation.

6.7 **Oliver Creek (#373).**

GEOLOGY MAP 70

Oliver Creek to Gate Place

(Saucedo and Wagner, 1992)

7.0 Cabin ruins on the right (west).

7.1 Mine shaft on east side of canyon, west side of road, on right (west).

7.45 (MP 26).

7.65 Cross unnamed creek.

7.7 Road to cabins on Little Grizzley Creek.

8.5 Contact between Goodhue Formation metavolcanics (Pzv to west) and Reeves Formation metasediments (Pz, to east).

9.0 Road to right goes south down to Grizzley Creek.

9.5/0.0 Intersection of Nye Cutoff Road. Go straight ahead on U.S.F.S. Road 25N42 (e.g. Walker Mine Road) toward the Walker Mine and Lake Davis.

0.2 (MP28)

0.3 Cross Blakeless creek.

0.6 Cross fault which places Reves Formation to the north against Cretacous-Jurassic granodiorite to the south.

0.7 Sign "Little Grizzley Creek 1/2 mi". Stay to the left and go southeast on the Walker Mine Road.

1.2 Granodiorite.

1.25 (MP 29)

1.4 Abandoned road on the right (south).

1.8 MP 21 on left.

2.0 Mine tailings can be seen on the right (south).

2.1/0.0 Access road to the Walker Mine. Turn left and go .02 miles northeast to the Walker Mine on U.S.F.S road 24N09.

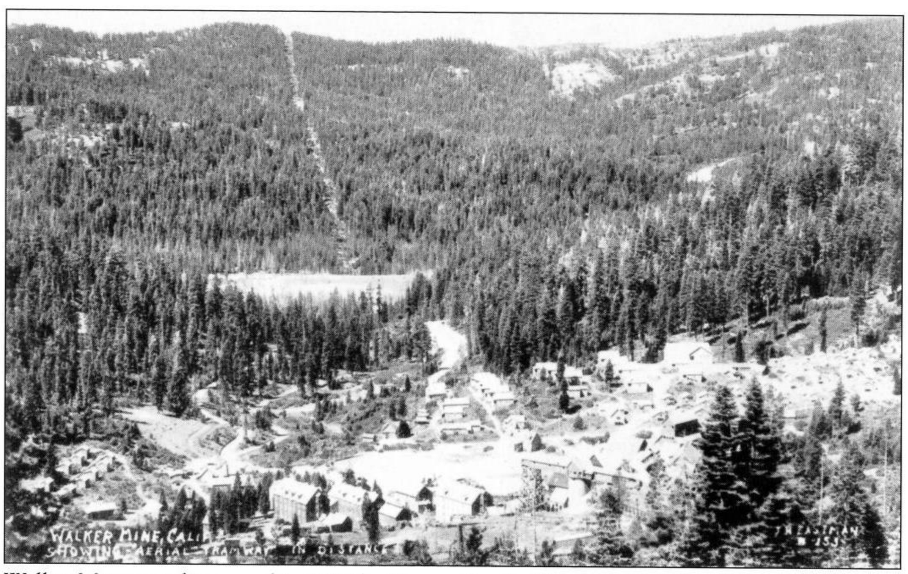
WALKER MINE (#374)

The Walker Mine was discovered in 1904. The mine was a company town, and was isolated from the world during the winter. The only way for people to get to and from the mine, in winter, was in a tram bucket. The tram brought in all necessary supplies, as well as the mail.

The mine was discovered by J. R. Walker, G. L. Bemis & A. H. Bemis. Mining started about 1911 and lasted until 1942. There were 500 persons on the payroll in the mine and mill at the height of operations. In 1940 there were 132 company houses, 68 private homes, 4 large bunk houses and a modest business district. The concentrate from ore produced at a rate of about 1,400 tons per day was transported to Spring Garden by the Wells Brothers Trucking Company during good weather. The rest of the time (winter) the concentrate was transported by Aerial Tram, the "Life-line" of Walker Mine. The ore cars measured 3x4x3ft. and carried 800# each. Supplies, mail, payroll & passengers had special cars for the chilly trip. Henry Giesendorfer was the mine Superintendent for many years. The mine was closed due to the high cost of keeping water pumped from the mine as well as the low price of copper. Norman Carlile, worked there as a mining engineer in 1936 and again in 1941-2.
http://www.ghosttowns.com/states/ca/walkermine.html (Oct. 28, 2008).

Here is the cook from the cookhouse standing on a stump and looking down over the town. This photograph points out the structures at Walker: No. 1 is the theater and schoolhouse, which was also used for dances; No. 2 is the main office; No. 3 is the tram house, No. 4 is the grocery store, No. 5 is the hospital, and No. 6 is one of the bunkhouses that the company had for its employees.

Figure 108. Walker mine complex and cook. From McCutheon, 2008:89.



Walker Mine was discovered in 1904 by George Bemis. He and Joseph R. Walker incorporated Walker Mining Company in 1909. The first flotation mill was built in 1916 and control of the company was acquired by the Anaconda Copper Mining Company in 1918. A 9-mile-long aerial tramway was built to Spring Garden to connect with the Western Pacific Railroad that year. Thus began a 23-year period of expansion and production. In the top photograph, the aerial tramway is in the background, the tailings dam is in the center, and in the foreground are the Walker Mine town site and mill. In the bottom photograph is a close up of the mill and bunkhouses. By the time the mine closed in 1941, it had produced 167,788,000 pounds of copper and substantial values in gold and silver.

Figure 109. Walker mine complex showing tram route. From McCutcheon, 2008:89.

The following is found in the report by Smith (1970), "Trace Elements in the Plumas Copper Belt":

The Plumas copper belt in Plumas County, California, extends 18 miles from the Superior and Eagle mines on the north to the Walker mine on the south, This copper belt is associated with granitic plutons. The important copper minerals at the major producing mines are chalcopyrite and bornite.

Distribution of copper, lead, zinc, molybdenum, silver, tin, bismuth, antimony, arsenic and boron in the eight granitic plutons in the Plumas copper belt shows an anomalously high content of copper in only one of them, the quartz monzonite of Lights Creek.

High copper values occur in four places in the Lights Creek pluton. The zonation of lead in the Lights Creek pluton roughly corresponds to the copper zonation. Zinc however grades from local high values near the center of the pluton to lower values near the margin. Zones with high values of molybdenum and tin correlate with each other and coincide in the part with zones of high copper and lead values near the boundary of the pluton. Mineral deposits at the Superior mine, in the southern part of the Lights Creek pluton, are considered to be sygenetic; i.e., the copper sulfide mineralizing agent was derived from the stock as a product of late stage concentration of the pluton's high copper content, through magmatic and hydrothermal processes.

The quantities of trace elements in the Lights Creek pluton were compared with the amounts in samples of seven other plutons. Three of these showed a relatively high copper content. The high copper values of one of these, the diorite at the Walker mine, suggests that it might be further explored for low-grade copper deposits. The amount of metal obtained in the past from each deposit in the Plumas copper belt is reflected in a relative way in the trace metal content of the pluton with which that deposit is spatially associated. For example, high trace copper values as found in the Light Creek stock relate to significant copper production from the Superior mine, whereas low copper values in the Genesee pluton are spatially related to copper prospects with only minor production.

The Walker mine occurs in an andalusite schist and horn-fels near the contact of a dioritic pluton, which is exposed only in the underground haulage adit. At the Walker mine, five ore bodies were aligned in a northwesterly direction (N.20-30W, dipping 32-70E). The ore bodies occurred in quartz veins within a northwest striking shear zone that cuts basic schistose and hornfelsic rocks near a contact with intrusive quartz diorite. The fine-grained , black, andalusite-garnet schist and cordierite hornsfels are in part tourmalinized. Chalcopyrite is the principal ore mineral, but minor proportions of chalcocite and tetrahedrite are present. Averill (1937) reported spalerite, galena, stibnite, and jamesonite as accessory minerals. The copper ore occurred primarily as massive bodies but also as vein and fracture filling in the host rock. During development at this mine, 3,000 feet of intrusive rock were penetrated before reaching the massive copper sulfide mineral deposits contained in the metamorphic host.

The oxidizing cap at the Walker mine can be traced on the surface for about one mile, but its lack of secondary copper minerals gives little indication of the high-grade ore deposits that were underneath. The ore bodies ranged from 600 to 1,400 feet in length and averaged 30 to 40 feet in width.

After 60+ years of abandonment, the Walker mine continues to have many environmental problems including acid mine drainage and heavy metal contamination. The U.S. Forest Service is experimenting with several new techniques to correct these problems.

Figure 110. Walker Mine mill foundations, 2008.


Figure 111. Walker Mine main portal, 2008.

0.0 Return to Walker Mine road. Turn left and go south toward Lake Davis. Sign says “Lake Davis 9 miles, Portola 26 miles”

0.1 Salvage logging area on the right (east).

0.7 Overlook to west of Walker Mine tailings with snow fences. These have been placed here by the U.S. Forest Service to increase accumulation of snow on the tailings. The additional snow is helping to flush toxic compounds from the tailings.

1.0 Cretaceous-Jurassic quartz diorite.

1.1 Unnamed creek crossing.

1.2 Cattle guard.

1.3 Sign "Emigrant Creek 1.0 mile" to the left (south). Go straight ahead.

1.7 U.S.F.S. Road 24N92Y

1.8 Site of historic settlement of **Lovejoy (#350).**

LOVEJOY BASALT

Between the Walker Mine and the site of the now-abandoned town of Lovejoy (#350) are two ridges that expose the Lovejoy Basalt.

2.1 (MP 32) Lovejoy Creek crossing.

3.0 Blakeless Creek crossing.

3.2 U.S.F.S. Road 24N54 on the left (north).

3.7 Road crest and cattleguard. Area undrelain by decomposed quartz diorite. The elongated hill to the west, east of Little Summit Lake is underlain by Reeves Formation.

3.8 U.S.F.S. Road 24N98 on right (west)

4.2 Unnamed creek crossing.

4.5 Road to Summit Lake on the right (southwest). Go east toward Portola.

4.9 Logging area on the left (north).

5.25 Cattleguard.

5.35 Road to Turner Ridge on the right (north). Go straight (east) toward Lake Davis.

5.7 **Midway House Site (#348).**

6.1 (MP 36) Road to old house settlements on the left (north).

6.2 Unnamed creek crossing.

GATE PLACE JUNCTION (#347)

7.0/0.0 Gate Place Junction.

GATE PLACE JUNCTION TO PORTOLA

GEOLOGY MAP 71

Gate Place to Don Blough Cove

(Saucedo and Wagner, 1992)

0.0 Intersection of Beckwourth-Greenville Road and Walker Mine Road. This is the site of the now-abandoned settlement of Gate Place (#347 The fastest way to get to Portola from this intersection is to go straight east for 18 miles. But we will take a more scenic way.). Go south on Beckworth-Greenville Road.

0.1 Cross Little Grizzley Creek

0.75 Intersection of U.S.F.S. Road 24N57 and Beckwourth-Greenville (Willow Springs). Go southwest on Beckwourth-Greenville toward Freeman Creek.

1.4 Historic logging area to the left (east).

2.2 Freeman Creek Access Road on the left (east).

2.3/0.0 Road junction. Go straight (east) on Beckwourth-Greenville Road. The road to the south will take you through Three Mile Valley to Highway 70. A sign here reads "Portola, 12 miles."

0.9 **Cow Creek (#352).**

1.2 Road to south goes into the Game Preserve.

1.8 Road to south.

2.0 Cross unnamed creek. Underlain by granodiorite.

2.7 Road to left (east).

2.75 Road to right (west).

2.85 Cross unnamed creek.

2.95 Road to left (east) goes to Jenkins Creek.

3.7 Old Camp 5 Boat Ramp on left (east) goes to Dan Blough Cove (#353)..

4.1 Road to right (west).

4.3 Road follows unnamed creek.

4.5 Road Cross Don Blough Creek.

DON BLOUGH COVE (#353)

GEOLOGY MAP 72

Don Blough Cove to Portola

(Saucedo and Wagner, 1992)

4.6 Road on right (west) goes to Eagle Point.

5.3 Cross creek.

5.45 Road to right (west).

5.6/0.0 Road junction. Turn right (south) on paved Lake Davis Road road toward Portola. Sign "Portola 5 mi".

0.7 Green dike in granodiorite.

1.5 Boundary for Plumas National Forest. The roadway follows Humbug Creek (#354).

3.0 Road cross Humbug Creek.

3.4 Charles Valley.

4.4 Portola School.

PORTOLA (#374)

5.7 Portola.

The City of Portola, *The Pride of the West*, is the only incorporated city in Plumas County. Its heritage has transitioned over the years from a stage stop for early Gold Rush pioneers to an essential rail yard for the former Western Pacific Railroad, and it is now a modern community.

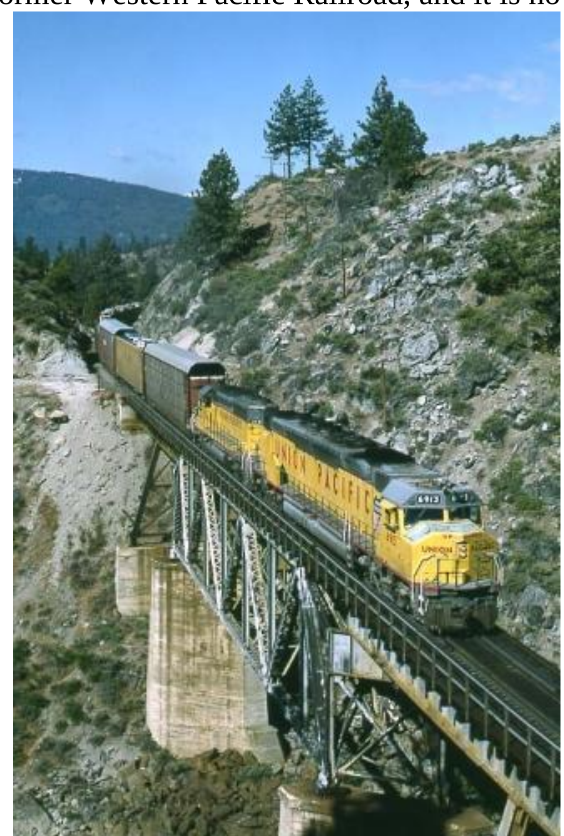


Figure 112. Santa Fe train on bridge crossing the Feather River. From http://www.ci.portola.ca.us, Oct. 28, 2008.

Portola is home to the Beckworth Museum. Jim Beckwourth was an African American who played a major role in the early exploration and settlement of the American West. Although there were people of many races and nationalities on the frontier, Beckwourth was the only African American who recorded his life story, and his adventures took him from the everglades of Florida to the Pacific Ocean and from southern Canada to northern Mexico.

The Jim Beckwourth Museum is a well preserved 1850`s log cabin, believed to be the third such cabin built by Jim Beckwourth as a trading post and `hotel` in the Sierra Valley. The cabin is constructed of `V` notched logs of the type used in the area where Beckwourth grew up.

The museum is open weekends from 1-4 p.m. Memorial Day through Labor Day and other times by appointment. Admission is free. To Reserve a Tour Call: (530) 832-4888 (http://www.ci.portola.ca.us, Oct. 28, 2008**).**

PORTOLA TO BLAIRSDEN

GEOLOGY MAP 73

Portola to Betterton Creek

(Saucedo and Wagner, 1992)

5.1/0.0 Intersection of West Street and Highway 70 in Portola. Turn right and go west toward Graeagle.

1.8 Cross Humbug Creek

3.2 Feather River access road.

4.7 Cross Willow Creek

5.2 Boundary for Plumas National Forest.

7.1 Cross **Betterton Creek (#375).**

GEOLOGY MAP 55

Hayden Mine to Blairsden

(Saucedo and Wagner, 1992; Durrell, 1976b, Potter, 1986)
(Schweickert and Hanson, 1984;Potter, 1986)

8.2 Blairsden Hill road on right (north).

9.3 **Intersection of Highways 70 and 89 (#307),** in Blairsden.

APPENDIX I

SIDE TRIP FROM GENESSEE TO DAVIS LAKE (GATE PLACE JUNCTION) BY WAY OF BAGLEY PASS

GEOLOGY MAP 68

Taylorsville to Genesee

(Saucedo and Wagner, 1992)

0.0 Genesee (#340). Proceed east on the Beckworth-Genesee Road. This road follows the north side of Genesee Valley.

GEOLOGY MAP 74

Genesee to Drum Bridge

(Saucedo and Wagner, 1992)

7.9/0.0 Intersection of Beckworth-Greenville Road and Beckworth-Genesee Road (Section 36). Proceed south and east on Beckworth-Greenville Road, toward Flournoy Bridge.

0.05 **Flournoy Bridge (#341).**

0.1 Nye Creek Road on the right (west). This road leads to Ward Creek. Turn left and go southeast toward Red Clover Creek.

0.3 Cretaceous-Jurassic quartz diorite.

1.2 Gravel Road on left (east)

1.5 Cretaceous-Jurassic quartz diorite.

2.4 River rapids on the left (east) on Red Clover Creek.

2.75 Red Clover Creek crossing. Ruins of a **Drum Bridge (#342).**

GEOLOGY MAP 75

Drum Bridge to Coldwater Creek

(Saucedo and Wagner, 1992)

3.5 Cretaceous-Jurassic quartz diorite.

3.65 Cross unnamed creek.

4.9 Cross unnamed creek.

5.65 U.S.F.S. Road 25N54 to left (east).

7.1 Campground on left (east).

7.55 **Notson Bridge (#343).**

7.6 Mudflows.

8.2 Mudflows on canyon wall to the left (east).

9.7 Sign "Dead End Road 1/2 mile" on the left (east).

10.4 Mudflows.

10.8 Crystal Creek crossing.

11.4 Crossing **Coldwater Creek (#344).**

GEOLOGY MAP 76

Coldwater Creek to Gate Place

(Saucedo and Wagner, 1992)

12.1 Unnamed creek crossing.

14.2 U.S.F.S. Road 25N97.

14.45 Unnamed creek crossing.

14.7/0.0 Intersection of Beckworth-Genesee Road on County Road 112 in Red Clover Valley (#345). Turn right and proceed south on the Beckworth-Genesee Road toward Bagley Pass (#346).

0.8 U.S.F.S. Road 24N08 with sign "Lake Davis 3.0 mi". Turn left and go southeast on this road toward Bagley Pass and Grizzley Valley.

2.2 **Bagley Pass (#346).** At Bagley Pass, go southeast toward Lake Davis.

3.0/0.0 Beckworth-Genessee Road and Bagley Pass Road. Go west on Bagley Pass Road toward Gate Place Junction (#347).

0.5 Following the north shoreline of Davis Lake.

2.5 **Gate Place Junction (#347)** at Davis Lake.

APPENDIX II

POINTS OF INTEREST BETWEEN CELESTIAL VALLEY AND GOODYEARS BAR ALONG HIGHWAY 49

GEOLOGY MAP 43

Covered Bridge to Pike
(Saucedo and Wagner, 1992; Bobbitt, 1982; Eddy, 1985)
(Hacker, 1984; Yeend, 1974; Edelman, 1986)

0.0 Intersection of Ridge Road (to Alleghany) and Highway 49. Go north toward Goodyear's Bar and Downieville.

CELESTIAL VALLEY (#263)

Between Celestial Valley (# 263) and Log Cabin (#281, SE Section 10), Highway 49 is underlain by Juassic granite of the Yuba Rivers Pluton.

1.9 Marysille Road to Dobbins. A contact between granite to the southwest and Mesozioic-Paleozoic metasediments of the Central Belt to the northwest is near this intersection.

NORTH YUBA RANGER STATION (#281)

2.9 Ranger Station.

GEOLOGY MAP 47

Yuba Ranger Station to Fiddle Creek
(Saucedo and Wagner, 1992; Hietannen, 1976, 1981)
(Edelman, 1986; Bobbitt, 1982; Eddy, 1985; Yeend, 1974)

2.6 Central Belt (formerly mapped as Calaveras Complex, Bowen and Crippen, 1949) slates and metasediments.

3.5 Camptonville exit with Tertiary gravels on left.

CAMPTONVILLE (#282)

The placer and hydraulic town of Camptonville (#282) is located half a mile off Highway 49, 8.4 miles northeast of North San Juan. Camptonville was founded about 1850 as a hostelry on the Nevada City-Downieville Road. The town boomed as the result of local gold discoveries in 1852. Few present-day buildings date back to gold rush days as the town was destroyed several times by fire. However, a quasi-colonial type of architecture prevails among the older frame buildings and the large frame hotel is a delightful spot shaded by large trees. Red, pock-marked, Eocene gravels outcrop on the hills to the northeast of town much as the gold diggers left them (Bowen and Crippen, 1949).

Figure 113. Camptonville main steet, 1880's.

During the Gold Rush, Camptonville, California, was a bustling stage-stop of 1,500 people on the route between Marysville and Downieville. Camptonville survived major fires in 1889, 1908 and 1959, and it was rebuilt every time by people who couldn't bear the thought of leaving.

This community has survived winters with so little rain that wells went dry - and others with so much rain and snow that people had to be rescued from their own homes. The Fire of 1908 destroyed most homes and businesses. Trade and traffic bypassed Camptonville

when Highway 49 (then Highway 25) opened in 1920.
(from http://www.camptonville.com/, Sept. 12, 2008).

Figure 114. Hydraulic pit near Camptonville. CDMG Bulletin 141, p. 18.

Half a mile below the Camptonville turnoff, a group of pegmatite and aplite dikes stand out of the deeply weathered bedrock. The light colored minerals of the dikes show little evidence of weathering whereas the biotite-rich matrix is decomposed. Half a mile above the Camptonville road deeply weathered cleavable meta-volcanics can be seen lying below the deep red soil mantle and below Tertiary gravel deposits. The metavolcanics are so decomposed that they disintegrate when tapped with a hammer. Few places so clearly illustrate the relationship between the deeply weathered rocks of the Eocene surface, the Eocene channel gravels, and the present-day land surface. The road cuts are also an excellent study in direct formation of soil mantle from parent bedrock lying immediately below (Bowen and Crippen, 1949). One half mile north of Camptonville, where Highway 49 curves to the east, near the center of Section 2, the Slate Creek thrust fault, dipping to the west, places ultamafic rocks of the Slate Creek Complex over metasedimentary rocks of the Central Belt.

Between Camptonville and the Frog Hollow public camp (#283), several small bodies of deeply weathered gabbroic rock outcrop along the roadside. These were apparently too small to be mapped by the early members of the Geological Survey (1985-1900). They mapped this entire area as amphibolite but this designation covers a wide variety of rock types including fine grained basic and intermediate intrusives, green meta-volcanics, mica schist, and the aforementioned gabbro (Bowen and Crippen, 1949).

3.8 Contact between metasedimentary rocks of the Central Belt (formerly mapped as Calaveras Complex, Bowen and Crippen, 1949) and Slate Creek Complex metavolcanic rocks.

4.2 Gabbro and diabase outcrops of the Slate Creek Complex on east side of roadway.

4.5 Highway 49 follows Willow Creek.

5.6 Cross contact between Slate Creek Complex gabbro and Slate Creek Complex metadiorite.

5.8 Willow Creek Campground.

FROG HOLLOW (#283)

6.5 Road to Frog Hollow (#283).

Frog Hollow, three miles north of Camptonville, is the first of a series of public camps scattered along or near the North Fork of the Yuba River. Frog Hollow is on Willow Creek which is not a tributary to the North Fork of the Yuba but runs into Bullard's Bar reservoir to the west of Camptonville. These public camps lie in a naturalist's and fisherman's paradise and are likewise good base camps for the geologically minded. The 36 miles between Frog Hollow and Sierra City lies through excellent outcroppings of a wide range of igneous and metamorphic rocks of great interest to petrologists and rock lovers of all kinds (Bowen and Crippen, 1949).

7.6 Sierra County-Yuba County Line

8.0 Contact between Paleozoic Slate Creek Complex metasediments and Eocene conglomerates is to the north. Tertiary gravels underly the village of Oak Valley on the left (north). To the south of Highway 49 is Slate Creek Complex metadiorite.

JOUBERT HYDRAULIC DIGGINS (#284)

8.1 Joubert Hydraulic Diggins on the right (east).

In the vicinity of the Joubert hydraulic diggings, the highway crosses from Yuba to Sierra County. Sierra County is famous for the many large gold nuggets it has produced. One from the Monumental Mine at Sierra Buttes weighed 1,596 oz. troy, worth $17,654. The placers of French Ravine produced four nuggets which weighed from 93 to 532 oz. each. Henry G. Hanks in his compilation of famous gold nuggets published in 1882 lists no less than 13 Sierra county nuggets among the 83 largest produced in the world to that date. The Ruby Mine, previously mentioned in connection with Alleghany, was producing sizeable nuggets and 1949 and continues to do so (Bowen and Crippen, 1949).

Highway 49 passes through the heart of the Joubert hydraulic diggings and the Eocene gravels and clays can be studied there at close range. The Joubert deposits contain a large percentage of white clay which would be valuable if it could be separated from admixed gravels. Some areas are of almost pure white clay. Other parts of the deposit have off-colored clays ranging from deep red to lavender. Clay deposits are present in association with many other Eocene gravel deposits of Nevada, Yuba, and Sierra Counties but, to date, the only clays of the Sierran foothills that are being worked are at the edge of the Sacramento Valley, principally in the vicinity of Ione, Amador County (Bowen and Crippen, 1949).

The Joubert Diggings are an excellent example of modern mining and land management practices. There is a recently reclaimed mining operation here and next to it one that is still in operation. The U.S. Forest Service plans to convert the active mining operation into a wildlife viewing area once the mining company has completed mining of the gold-bearing gravels at this deposit. This conversion has already been accomplished in the Indian Valley hydraulic pit a few miles to the north.

FIG. 36. Joubert hydraulic pits in Sierra County. Highway 49 runs directly through these diggings. *Photo by Olaf P. Jenkins.*

Figure 115. Joubert Pit. CDMG Bull 141, p. 79.

A splendid panorama up the V-shaped canyon of the Yuba may be seen 2.6 miles northeast of Joubert just before the highway descends to the level of the river. Youthful stream profiles may be seen at other points along the highway between Joubert and Downieville (Bowen and Crippen, 1949).

A thick series of partially metamorphosed volcanic rocks is exposed in the vicinity of the highway bridge over the North Fork of the Yuba. Amygdaloidal flows, agglomerates and tuffs may be seen in various stages of metamorphism, some completely recrystallized to schist and others in the lavas along the dirt road leading off to the north of the bridge. Good parking places may be had along this road and exposures are good along the river and in places along the road (Bowen and Crippen, 1949).

8.5 Slate Creek Complex rocks.

One half mile west of the eastern edge of the switchback in Section 19, Highway 49 crosses a fault which places Slate Creek Complex metavollcanic rocks to the west against Slate Creek ultramafic rocks and Central Belt metamorphic rocks to the east.

11.3 Cross North Fork of the Yuba River. At this bridge there is a contact between Central Belt metasedimentary rocks and Slate Creek ultramafics to the west and Late Jurassic/Early Cretaceous granodiorite to the west.

11.9 **Fiddle Creek Campground (#361).**

GEOLOGY MAP 48

Fiddle Creek to Goodyear's Bar

(Saucedo and Wagner, 1992; Hietannen, 1976, 1981)
(Edelman, 1986; Bobbitt, 1982; Eddy, 1985; Yeend, 1974)
(Southern Pacific Company, 1959; Hacker, 1984)

INDIAN VALLEY CAMPGROUND (#285)

12.9 Campground

Indian Valley public camp, the second of a series of excellent camp sites beside the river, is located east of the Yuba River Bridge. The granodiorite which was seen at that bridge (mile 11.3 above) is well exposed in the quarry east of Indian Valley camp. It has the same petrology as the granodiorite south of Camptonville. The granodiorite intrusion is exposed in a 1.7 miles section of Highway 49 in this area (Bowen and Crippen, 1949).

13.4 Placer workings on right (south).

13.5 Massive beds in Slate Creek Complex.

13.7 Humbug Creek tributary flows into North Fork of the Yuba River on the right.

15.3 Convict Flat.

15.9 One-quarter mile thick sliver of metasedimentary rocks of the Central Belt.

16.4 Placer workings on south side of North Fork of the Yuba River.

17.6 More placer workings on south side of river.

RAMSHORN CAMP GROUND (#286)

18.2 Ramshorn Camp Ground (#286) on Ramshorn Creek which marks the position of the Ramshorn Fault. This fault juxtaposes Slate Creek metavolanics and ultramafics to the east against Central Belt metasedimentary rocks to the west.

19.0 BALD TOP MOUNTAIN (#287)

Midway between Ramshorn Creek and Goodyears Bar (#280), good views of the columnarly jointed basalt of Bald Top Mountain may be seen to the north. The Bald Top and adjacent lavas represent the latest period of Sierran volcanism with the possible exception of some flows on the east side of the range (Bowen and Crippen, 1949).

19.2 Serpentine of Ramshorn Fault Zone (Feather River Peridotite Belt).

19.6 Metavolcanic rocks.

GOODYEAR'S BAR (#280)

20.0 Goodyear's Bar (#280). THE ROAD LOG ALONG HIGHWAY 49 CONTINUES ON GEOLOGY MAP 49.

APPENDIX II

LIST OF MAPS

G-67	Superior Miner to Engles Mine
G-68	Taylorsville to Genesee
G-69	Genesee to Oliver Creek
G-70	Oliver Creek to Gate Place
G-71	Gate Place to Don Blough Cove
G-72	Don Blough Cove to Portola
G-73	Portola to Betterton Creek
G-74	Genesee to Drum Bridge
G-75	Drum Bridge to Coldwater Creek
G-76	Coldwater Creek to Gate Place
R-06	Coloma to Nevada City
R-07	Nevada City to La Porte
R-08	Goodyear's Bar to Quincy
R-09	Moonlight-Engles Project Area
R-10	Bassetts to Walker Mine

APPENDIX III

GLOBAL POSITIONING SYSTEM WAYPOINTS FOR POINTS OF INTEREST

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